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	Page
Empire Cables	205
Marine Galvanometer and Adjustable Universal Shunt used as a Direct-Reading Milammeter or Voltmeter (*illus.*) ...	208
Electric Tramway and Railway Exhibition, 1905 (*illus.*) (*cont.*)	209
A New Carbon Filament (*illus.*)	213
Correspondence	215
Reviews	216
The Prevention of Overhead Accidents (*illus.*)...	218
Physical Society	220
Business Notes	220
City Notes	229
Stocks and Shares	232
Share List of Electrical Companies	233
Market Quotations	234
The Faraday Society (*illus.*)	235
Parliamentary	236
Coal Gas and its Rivals for Motive Power	243
New Patents Applied For	244
Published Specifications	244

THE

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EMPIRE CABLES.

THE Pacific Cable Conference—at which the various partners in this Imperial enterprise were represented—held its last sitting a fortnight ago; and, although no report of the proceedings will be made public for some time, we are given to understand that the delegates were unanimous in their support of the scheme, and were also agreed in their desire to get rid of the obstacles which stand in the way of the Pacific cable's success. We understand that the most important of the objections raised are to an agreement, which is now being made, or renewed, between the Government of New South Wales (or of the Commonwealth) and the Eastern Extension Telegraph Co., whereby the Government, one of the partners in the Pacific cable, proposes to grant special facilities to the company, without consulting the other Governments concerned. Another objectionable feature which has, doubtless, been under the consideration of the Conference, is the high terminal rate exacted by the Australian Colonies for every word received, or sent by, the Pacific cable. The rate of 3s. per word for a telegram to Sydney, New South Wales, handed in at one of the Atlantic companies' offices in England is divided up as follows:—To the Atlantic Cable Co., 8d.; landlines in North America, 4d.; Pacific Cable Board, 1s. 7d.; Australian Government, 5d. The British Government makes no charge in respect of telegrams dealt with entirely by the companies, beyond the rent which the companies pay for the use of their special wires. On such telegrams as are dealt with at postal telegraph offices in England, the ordinary inland rate of ½d. per word is paid to the Post Office, out of the sum of 8d. accruing to the Atlantic cable companies. In connection with this portion of our subject, we should also state that the terminal rate charged by New Zealand is ½d. per word for inter-colonial telegrams, and 1d. per word on all others. When we remember that a telegram can be sent from any place in Australia to any other place within the Commonwealth for 1d. per word, it is difficult to realise how, in equity, the heavy terminal rate of 5d. should be charged by the Australian partners. If we assume that two-thirds of last year's traffic over the Pacific line was to and from Australia, then we find that the terminal rate charged more than cancels the amount which the Australian partners have to bear as their proportion of the deficit, and so one possible cause of complaint against the Motherland vanishes!

It is clear that such a relationship between the partners should not have arisen amongst such a brotherhood, and we can only hope that the labours of the Conference may result in the amendment of the position.

To turn to another aspect of Empire cables, of which, after all, the Pacific cable is only the advance guard, we would call the attention of our readers to a very able article from the pen of Sir Sandford Fleming, which appears in the *Empire Review* on "State Cables and Cheap Telegraphy." As most of our readers will know, the author of

this article has devoted much time and unflagging attention to the subject, and in the face of the strenuous opposition of some, and the indifference and procrastination of others, has at length managed to achieve, in the laying of the Pacific line under the auspices of six British Governments, the first and most important step in the beneficent scheme which he now elaborates. It is difficult, if not impossible, to summarise for the information of our readers the terms of an article so clearly and so concisely expressed. To clear the ground, we may at once state that "it is not suggested that the State should assume the control of ocean cables generally, but simply that one line around the globe should be State-owned; that this line should be the one described by the Ottawa Board of Trade as 'Empire Cables,' connecting, as it would, the several great outlying divisions of the Empire with each other, and all with the mother-country.

"It has been objected that prejudice to existing interests would be thereby created. To that stricture one may reply that, in so far as other cables intersect the line of the Empire cables, they would assume the position of branches, and would gain greatly by the connection. The true policy of the State should be to reduce progressively the charges for messages transmitted by the Empire cables to the lowest possible rates, while still leaving the service self-supporting. Two results would follow this policy: an enormous increase in the volume of business, and a great reduction in telegraph charges to and from all points on the globe-girdling chain. Both results would necessarily benefit the private companies owning the branch lines, by reason of the continuous stream of profitable telegraph traffic which the Imperial trunk system would bring to the companies to handle."

The writer shows, taking the Pacific cable as an example, how that line is quite capable of carrying 25,000 paying words per day of 24 hours, and that, working only half time, the low rate of 4d. per word would yield a revenue considerably more than sufficient to meet ordinary working expenses, this apart from the 6d. per word necessary to meet in full all charges made by the Treasury for interest, renewal and sinking funds to replace capital "on the very liberal scale suggested by Lord Selborne's Committee." The writer draws a comparison between the proposed 4d. (or even 10d.) rate and the 9s. 4d. previously charged by the companies, forgetting, apparently, that the 9s. 4d. was a through rate between Great Britain and Australia, while the proposed 4d. only covers a portion of that route.

Recognising, as even the associated companies themselves now cannot fail to recognise, the immense increase in traffic which follows on reduction of rates, Sir Sandford Fleming, from the knowledge which experience gives, assumes that when the Empire cables are completed it will be possible to create an immense volume of paying traffic, and goes on to advocate the devoting of the spare time of these cables to the free use of the Press and Press Associations, acting in harmony with an Imperial Council, combined with an Intelligence Department on the lines recently formulated by Sir Frederick Pollock and his friends. For such success as has been hitherto achieved in this piece of good work for the Empire we have to thank Sir E. Sasson, Sir Charles Dilke, and many others of the House of Commons Cable Committee.

"For the present, our greatest need is a better knowledge of each other, and if our object be to unify the Empire, all our people who live beyond the seas should as much as possible be brought practically into the neighbourhood of England and into the neighbourhood of each other. Before we can be expected to decide on any possible organic union to bind us together for all time, we should first know and understand each other, and the more thoroughly we can accomplish that purpose the easier it will be to realise the high ideal of Imperial unity." We have noticed lately in the daily papers a warning in which the gradual estrangement of even Canada from Great Britain, owing to lack of interchange of news, is referred to, and we are told that:—"In fact, were it not for constant emigration from Great Britain, the mother-land would have a Colony with as little family feeling as the United States itself." So we find that it is easier to send a man than to send a telegram—a clumsy way of sending a message!

We have noticed, in a weekly contemporary, an article to which we would refer our readers as to the broader points of a subject with which we are now dealing more widely, and we welcome a championship in what was once thought a lost battle.

Surely if the six British Governments above referred to (to say nothing of the other Colonies) found it advisable to expend considerably over £22,000,000 last year on primary education alone, the comparatively small prime cost (estimated at about £5,000,000) to establish a system of "Empire cables" is not too great a price to pay for a means of Imperial education, especially when there is a reasonable prospect that these cables, when the girdle is completed, will be self-supporting.

Paradox in Engineering.

The science of steam and electrical economy has nowadays become so cut-and-dried that there is danger of too much being taken for granted in engineering problems. Principles which are correct under standard conditions of practice are liable to be taken as fundamental, whereas special conditions may arise where their converse is true.

An everyday example of this economic paradox is the production of a vacuum. The superficial engineer views with satisfaction the 27 in. or 28 in. registered on his vacuum gauge, oblivious of the fact that it is taking perhaps twice as much circulating or injection water to produce that vacuum as would be necessary with 24 in. or 25 in. For a turbine a good vacuum is essential, but the small gain in efficiency of a reciprocating engine is oftentimes out of all proportion to the energy spent in producing a high vacuum. Moreover, high vacuum involves low temperature of ejected water, and where such water is used for boiler feed a further loss is experienced.

The whole question of condensing is, in fact, a financial one. Water, when transported some distance, becomes expensive, and must be used with care. In factories, it would often be worth consideration as to whether the heat of uncondensed steam could not be more economically utilised in drying coils, and for the heating of the buildings, and similar purposes. Loss of efficiency in the driving mechanism becomes gain to the shareholder of the company.

The reasoning of paradox may be extended to the human element in a works organisation. The policy of extracting as much as practicable from, and giving as little as possible to, the operative, sounds at first like good business policy. In the conflict of will that ensues, however, the appeal to force must be made. The knout is a very terrible instrument, but if used too frequently its thongs become frayed. Perhaps nowhere is discipline more perfectly observed than in ordinary conditions on a battleship, which is as essentially an organisation of mechanism as a workshop, though devoted rather to destruction than construction. The recent object lesson of the Black Sea fleet may, therefore, be taken to heart by every employer of labour who is trying to eliminate the element of *camaraderie* and reduce his workpeople to the status of machines. Money spent in baths,

eating-rooms and libraries is not uselessly sunk capital. A man in good health, fed with decent food at reasonable prices, and well-equipped mentally as regards the science of his work, will return with interest the money and time sunk in him. He will be another example of the paradox in engineering.

English 220-volt Lamps.

An abstract of a paper of some moment to incandescent lamp users in general, and to English lamp makers in particular, appeared in the *Western Electrician*, Chicago, for July 8th. The paper, which was presented at a June meeting of the American Institute of Electrical Engineers, and whose author is Mr. J. W. Howell, criticises in a very practical manner some remarks made last September by Col. R. E. Crompton, in the course of the discussion of the papers read at the International Electrical Congress at St. Louis by Mr. Torchio and Mr. Dow. The system of lamp supply to customers in the States is different from that prevailing here, as is also the electrical distribution pressure, and the papers referred to dealt with the advantages resulting from a low as opposed to a high-pressure system.

The gist of Col. Crompton's remarks is that in England, after starting electric supply on the three-wire system, and distributing at 110 volts, we have practically everywhere doubled the voltage, though not without a struggle on the part of lamp manufacturers, who maintained that customers using high-voltage lamps would be at a disadvantage, since the efficiency would be less. But, continues the Colonel, "we showed that this could be remedied by refinements in lamp manufacture, so that now it would be very difficult for the consumer to find that he was at any practical disadvantage on account of inferior efficiency of the double-voltage lamps."

Mr. Howell scrutinises these remarks very literally and drastically, and argues that either English 220-volt lamps are very much better than those made in America, or English 110-volt lamps are very inferior to the same type made in America, or, thirdly, that the considerations and conditions other than the difference in quality of the two types of lamps, which affect the choice of one system or the other, are different in the two countries. To settle the question of the quality of the lamps, 25 220-volt 16-c.p. lamps of the following five makes were obtained as being amongst the best known on the English market :—Sunbeam, Stearn, Royal Ediswan, Robertson and Cryselco. Run at the marked pressure, the average result was :—

Make	C	...	...	15·5 candles	4 watts	per c.p.
„	D	...	...	13·5 „	4·65	„
„	B	...	...	14·3 „	4·33	„
„	A	...	...	14·5 „	4·37	„
„	E	...	...	11·4 „	5·2	„

The nominal efficiency of the lamps was 4 watts per candle. Similar Edison lamps gave an average of 16·2 candles, and 3·83 watts per candle, and they showed much greater uniformity of candle-power than the English lamps.

To determine maintenance of illuminating power, a number of the several lamps were set up for a life, or, more correctly, a time efficiency test, and to make the comparison fair, all were started at 3·1 watts per candle. This efficiency was adopted on account of the limited time available for making the test. For comparison, similar lamps were selected at random from the stock of the American General Electric Co., and were started at the same efficiency. Run to 80 per cent. of the starting efficiency, the average results were as follows :—

Make	C	...	...	104 hours	to 80 per cent.
„	B	...	...	88 „	„
„	E	...	...	65 „	„
„	D	...	...	82 „	„
„	A	...	...	72 „	„
„	Edison	...	...	156 „	„

The results speak for themselves at this particular efficiency, and they are highly creditable to the American Edison lamp, but it may be pointed out that lamps in use, especially in the early stages, often vary appreciably in resistance, and thus, owing to the development of blackening and other changes, the illuminating power becomes differently affected.

As to the standard 110-volt lamp, of which millions are in use in America, samples are regularly tested for life. The curve showing loss of candle-power obtained from an average of some thousands of these tests, indicates, with a starting efficiency of 3·14 watts per candle, a useful life of 512 hours when run to an 80 per cent. efficiency, and the lamp thus possesses three times the useful life of the 220-volt Edison lamp. "It is our experience," says Mr. Howell, "based on many tests, that 110-volt lamps of 3·1 watts per candle, and 220-volt lamps at 3·8 watts per candle, have equally useful lives."

Mr. Howell concludes by supposing that if Col. Crompton's standpoint is true, the British public must be very ill-informed on the subject of the quality and performance of lamps. Be this as it may, there can be little doubt that Col. Crompton and everyone else who has examined into this question, must be aware that the lower voltage lamp is decidedly the better article. This was clearly demonstrated in the case heard not so many years ago between the Westminster Electric Supply Co. and the Junior Constitutional Club. The great contention of high *versus* low distribution pressure has not, of course, been decided in this country in favour of high pressure on the quality of the different types of lamps, or it never would have been witnessed. It was decided on by other economic conditions, to the great advantage of the distributing agencies, and, to a less extent, to the advantage of the lamp consumer, and it now behoves the latter to set off the benefit of a cheap supply of energy against the drawbacks of an inferior class of lamp. He may, however, reasonably expect to receive a gradually improving lamp, and Mr. Howell is working hard to this end, as will be seen from an article in another part of our present issue.

The Russian Platinum Output.

In view of the present high price of this metal, which readers of our fortnightly list of prices will note is in the neighbourhood of 83s. per oz. troy, special interest attaches to a report from Mr. Consul Wardrof, at St. Petersburg, which, in dealing with the foreign commerce of Russia, gives what is presumably the latest information on the subject. Of the world's consumption of platinum about 95 per cent. comes from the Ural district, the total production in 1902 being nearly 6 tons. There are two or three refineries in Russia, but most of the product is exported in its raw state. The yield for 1903 is estimated at 5·7 tons, and for the first ten months of 1904, 4·7 tons. It is said that little enterprise is shown in prospecting, but the recent discovery of two nuggets respectively 20½ and 9½ Russian lbs. in weight, has had a stimulating effect. During 1904 there was a considerable shortage in production in the case of the larger firms who had entered into contract on the basis of the previously ruling lower prices.

Permanent Magnets of Cast-iron.

In the *Proceedings* of the American Academy of Arts and Sciences for April, 1905, there appeared a paper by Mr. B. O. Peirce on the use of cast-iron for permanent magnets for galvanometers. Amongst the various advantages claimed for hardened cast-iron over tool steel are the following :—The metal is more readily manufactured into awkward shapes. Greater uniformity is obtainable in regard to its magnetic qualities. The variation with temperature is smaller. The magnets are more permanent, and can be magnetised up to at least the same degree of induction. Grey cast-iron is recommended, and after all machining has been completed, it should be hardened by heating up to very nearly its melting temperature, and then suddenly cooling it. Unless heated up to this high temperature before cooling, the magnets will not be permanent. For details of the process of ageing and tests for permanence, we would refer our readers to the original paper.

MARINE GALVANOMETER AND ADJUSTABLE UNIVERSAL SHUNT USED AS A DIRECT-READING MILAMMETER OR VOLTMETER.

By J. RYMER-JONES.

The diagram below illustrates an ordinary Wheatstone bridge connected up for localising a low resistance break, by one of the various C R tests in which the current through the fault has to be measured.

The dead-beat marine galvanometer G_1 is provided with an adjustable universal shunt U S_1, because when not performing its more usual function as the bridge galvanometer, it is often required to serve other and widely different purposes.

For instance, it may be switched over to the signalling key and employed as a convenient signalling instrument

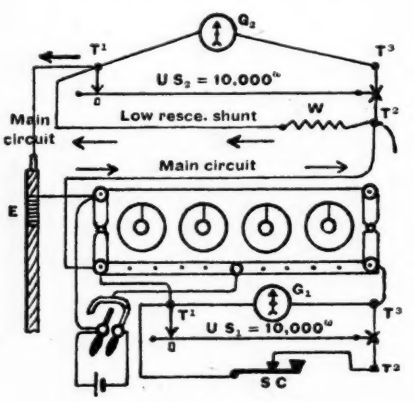


Diagram of Connections.

when speaking through a very short section of cable to the shore station, where sometimes the Morse system is not employed; or, on the other hand, when the K R of the cable is too high for rapid Morse signalling.

The second galvanometer G_2, with its adjustable universal shunt U S_2, is ordinarily used for the D R and capacity tests, but when desired can temporarily be converted into a direct-reading milammeter, and used as such in the cable circuit of the bridge system, as illustrated in the figure, or with equal facility into a direct-reading voltmeter. G_2 and U S_2 as a milammeter.

The terminals of galvanometer G_2 coil are connected to the extreme ends T_1 and T_3 of the universal shunt coils of 10,000ω.* T_1 and T_2 are in that part of the main circuit through which the testing current enters the cable. Of these T_2 is the adjustable contact, whereas the positions of T_1 and T_3 we may here consider unchanged, as this vernier adjustment is only required for the final and more exact adjustment, which we need not now consider in explaining the principle of the milammeter.

A rather stout German silver wire W, of a few ohms only, connects the terminals of T_1 and T_2 and permanently bridges over whatever part of the 10,000ω is included between them, so that the resistance of this part of the main circuit remains practically constant, viz., that of the German silver wire, irrespective of the position of the adjustable contact T_2, or the galvanometer resistance, and may be considered negligible.

When T_1 and T_2 are at the extreme ends of U S_2, the wire W, galvanometer coil, and 10,000ω are all in parallel. If then, under these conditions, a Clark's standard cell, of say 1·43 volt, be joined up in circuit with resistance coils adjusted to 1,430ω (*i.e.*, 1·43 × 1,000), and terminals T_1 and T_2 be also included in the circuit, the resulting deflection of G_2 will be produced by a current of 1 m.a. This has only to be done once for all whilst regulating the scale reading for subsequent use.

The object in view is to regulate the current traversing the shunted galvanometer G_2 so that the above one milliampere exactly produces a deflection of 100 divisions. This may very simply be done in either of two ways, as follows:—

It being borne in mind that the adjustable contact T_2 of U S_2 is at present at the extreme right end, and therefore T_2 and T_3 (to which latter one of the galvanometer terminals is connected) are together: if the deflection is too high, unclamp one end of the wire W and reclamp a shorter length till the deflection is 100; or introduce a longer length if the deflection is less than 100 divisions.

The writer uses a German silver wire 14½ ft. long, of 0·020 in. diameter, and giving 3·6 ohms, with his Sullivan marine galvanometer whose coil equals 1,020ω, in order to produce this deflection, the distance of the galvanometer from the scale being 3 ft. The galvanometer so shunted affords a sensitive milammeter which, when put into the broken cable circuit, shows the number of m.a. traversing the cable, due to fault polarisation, or earth current, or both, to two places of decimals, *e.g.*, 235 divisions indicating 2·35 m.a. If greater sensitiveness be required, double the resistance of W, and vary its length till $\frac{1{\cdot}43 \times 1{,}000}{1{,}430}$ gives 200 divisions. The readings for any other currents, within the limit of the scale, divided by 2 will then give the number of m.a. in the main circuit. On the other hand, to reduce the sensitiveness to one-tenth, in order to measure stronger currents, move T_2 from the 10,000ω stud towards the left to the contact stud representing $10{,}000 - 9\,g$ [where g is the resistance of the galvanometer]. The highest deflection available on the scale (say 550 divisions) will then equal $\frac{550}{100} \times 10 = 55{\cdot}0$ m.a. The rationale is simply that whereas the resistance between T_1 and T_2 remains practically constant, that part of the 10,000ω between T_2 and T_3 is added to the resistance of the galvanometer, and as the sum of these increases, the amount of current which passes through the galvanometer is proportionately decreased.

To reduce the deflection to ½, contact T_2 must be at $10{,}000 - g$ or 9,000ω if $g = 1{,}000$ω.

To reduce the deflection to ⅓, contact T_2 must be at $10{,}000 - 2\,g$ or 8,000ω if $g = 1{,}000$ω.

To reduce the deflection to ¼, contact T_2 must be at $10{,}000 - 3\,g$ or 7,000ω if $g = 1{,}000$ω, and so on.

The resistance of the galvanometer may quickly be ascertained by merely moving T_2 from its extreme limit to the right, towards the left, until any suitably large deflection of, say, 200 or 300 divisions is halved. The U S_2 reading substracted from 10,000 will then give the resistance g. For this the vernier arms T_1 and T_3, which move together, will have to be used as an auxiliary to T_2.

The second and alternative method of adjusting the current through the galvanometer by means of U S_2 in conjunction with the low resistance W, until the deflection is exactly 100 times greater than the milliamperes through the main circuit, is equally simple. With a Sullivan galvanometer coil of 1,020ω, T_1 and T_2 at the extreme ends of the 10,000ω, and bridged by the wire W of 4ω, a Clark's cell (1·43 volt) through 1,430ω gave 110 divisions. Instead of reducing the length of W to bring the deflection to 100 divisions, T_2 was moved to 9,900ω, thereby increasing the resistance in the galvanometer coil circuit by 10,000—9,900, *i.e.*, 100 ohms.

To reduce the current influencing the galvanometer to ½, in order to read from the same scale twice the number of milliamperes indicated by its graduation as above standardised, T_2 is moved to the left until the resistance between T_2 and T_3 plus that of the galvanometer coil is doubled. It has already been pointed out that the galvanometer resistance g may be quickly ascertained, when T_2 is at the extreme right of the 10,000ω, by halving any scale deflection; but if this has not already been measured and T_2 occupies, as in the instance under discussion, some other position, the total resistance of g plus $(10{,}000 - T_2)$ ohms in circuit with it may in the same way be found by moving T_2 further to the left till a moderately large deflection from any suitable E.M.F. is exactly halved. Keeping T_2 in this position, the same scale readings enable twice the number of milliamperes to be measured, as stated above. For instance, 456 divisions represents $\frac{456}{100} \times 2 = 9{\cdot}12$ volts.

From the foregoing particulars it will be evident that the

* Rymer-Jones pattern, with the vernier extensions at the extreme ends omitted to simplify the illustration.

galvanometer U S_2 and wire W can, when occasion requires, be employed as a very sensitive milammeter, suitable for currents of considerable range, and obviate the employment of a specially constructed portable instrument which is not nearly so sensitive or suitable for fault localisations.

The galvanometer and U S equally serve for a sensitive voltmeter—for which the wire W is not required—by adjusting the position of T_2, so that the current from a Clark's cell (1·43 volt) through a high resistance (say 100,000ω used for taking the *constant* for an insulation test) gives exactly 143 scale divisions, or 100 divisions per volt. Any other electromotive force, up to the limits of the scale readings, may then be substituted and read off to two places of decimals, *e.g.*, 435 divisions would represent 4·35 volts. If double this sensitiveness be preferred, move T_2 to the right to increase the shunt reading until the deflection from the standard cell through 100,000ω gives 286 divisions. A deflection from an unknown electromotive force giving, under the same conditions, 535 divisions will then be

$$\frac{535}{100 \times 2} = 2{\cdot}675 \text{ volts.}$$

On the other hand, ten times the voltage represented by the highest scale reading permissible in the preceding instance may be read directly from the same scale by moving T_2 to the left to give a multiplying power ten times as great. Thus: If T_2 is at 3,270 when the standard cell gives 143 divisions, the deflections must be multiplied by 10 when T_2 is moved to contact stud for 327ω, so that a deflection, from an unknown E.M.F., of 435 divisions would now represent $\frac{435}{100} \times 10 = 43{\cdot}5$ volts, and 552 divisions 55·2 volts.

The same principle applies for reading the E.M.F. in volts directly from the scale when a Schaefer bridge localisation test is employed.

The adjustable contact T_2 of U S_1 may be adjusted to such a value that when the *proportional part* on the cable side is altered momentarily to 10,000ω—in the manner explained by Mr. Schaefer when measuring the cable current voltage through a resistance of, say, 100,000ω—a Clark's standard cell applied to the bridge terminal, in the place of the cable, gives a deflection of 143 divisions through the same high resistance. If the cable current, observed under the same conditions, immediately after obtaining the bridge balance, gives (say) 75 divisions, its voltage is $\frac{75}{100} = 0{\cdot}75$ volt.

The writer has applied the same convenient principle of adjusting the galvanometer deflection by means of a universal shunt when measuring the C R at 75° F. of a large number of coils of cable core in the factory, having approximately the same resistance, by a bridge specially constructed for such low resistances as that offered by two or three knots of core conductor. To secure a highly sensitive bridge system, and prevent more current passing through one side than the other, equal proportional parts of 10 to 10 are employed. The adjustable coils (of the slide pattern) are 10 to 90, 1 to 9 and ·1 to ·9 ohms, and these are made of manganin to obviate temperature correction. These are able to produce an approximate balance, *i.e.*, to the first place of decimals; and U S_1 is so adjusted that a change of one-tenth ohm in the bridge produces a deflection of 100 divisions. Consequently any small further difference of resistance in the second and third places of decimals is read directly from the scale without waiting to get an exact balance. Thus, if 6·4 is too little and 6·5 too much, the deflection of say 82 divisions from zero, when only 6·4ω is unplugged, gives the additional resistance, viz., 6·482ω. This facilitates testing when many drums of core have to be quickly tested for cable manufacture. The leads are once for all balanced by a short length of wire, and, therefore, have not to be further taken into account.

Stourport.—A curious difficulty has arisen with regard to the proposal of the Kidderminster E.L. Co. to apply for a prov. order for E.L. By mistake the statutory notices respecting the application were sent to Stourbridge, and the error was not discovered until the time for sending the notice to Stourport Council had expired. In spite of this the notice was served, and the B. of T. on being appealed to on the matter intimated that it would not raise the question of the defective notice, but the promoters might have to meet the objection from other quarters.

ELECTRIC TRAMWAY AND RAILWAY EXHIBITION, 1905.

Description of Interesting Exhibits.

(Continued from page 199.)

Brakes.—What appealed to us most about this section was the absence of the two best known electro-magnetic brakes (in which we hear that certain improvements have been made since 1902) and the only pneumatic track brake.

Leaving aside the braking effect of regenerative control, not from any desire to slight the inventor, but because we are dealing with brakes pure and simple, Mr. E. Freund, Westminster, and Messrs. R. W. Blackwell had the field of friction brakes all to themselves. Mr. Freund exhibited a Bradford car, which had every appearance of being taken straight from service, and has been using his combined wheel and track brake for nearly two years.

We have seen spring actuated track brakes before—generally on paper—but we have never seen the disadvantages which surround such a device overcome in a more ingenious and satisfactory manner. The fact that this brake has been at work for so long on one of the heaviest roads of the country is proof enough that Mr. Freund's patent is not only pretty, but practical. Fig. 39 (p. 210) illustrates the general arrangement of the various parts, and it is seen that the pressure between the block and the rail is varied by subtracting the effect of one spring from that of another. This was demonstrated at the stall by means of a working model. A sheet of paper was inserted between the rail and the shoe, and the vertical pull on the block which had to be exerted before the paper could be removed without effort was measured on a spring balance, and found to vary over the whole scale according to the value of the resultant tension on the brake springs.

By fully releasing the brake-lever, the maximum brake pressure can be obtained instantaneously, so that it is an emergency and service brake in one.

The springs required are only about 4 in. in diameter × 24 in. long, while the construction of the brake is otherwise as simple as that of an ordinary hand brake. Other advantages claimed are the low price, small weight, and the possibility of putting the brake on before entering a down gradient.

The principle is also applicable to wheel-brakes, and it would be impossible with such wheel-brakes to obtain flats, as the maximum brake pressure is determined by the springs, and not by the driver's arm.

Mr. Freund considers the failure of a spring almost an impossibility, but he provides even for the impossible by adding safety connections which permit the brake to be used as a hand-brake in the event of a spring failing.

Messrs. R. W. Blackwell had an elaborate and complete colony of Christensen air-brake plants. This system has been described fully and illustrated in the Electrical Review (Vol. 44), and we need say here only that the demand for this equipment is increasing, and it is being supplied at the present time to the Metropolitan District Railway and to the Paris Metropolitan.

The capacities of the machines in cubic feet of free air per minute when compressing to 90 lb. per sq. in. were as follows:—

$$A_5 = 7{\cdot}5\text{; } A\,A_1 = 11\text{; } B_2 = 20\text{; } C_3 = 35\text{; } D_4 = 50,$$

so that the compressors shown covered all the requirements of railway and tramway work.

The D_4 machine shown was of the type furnished to the Underground Electric Railways Co. of London, Ltd., for the new electric trains of the District Railway, the Baker Street and Waterloo Railway, the Great Northern, Brompton and Piccadilly Railway, and the Charing Cross and Hampstead Railway, and up to the present 344 of these machines have been supplied or are on order.

The brake equipment shown is the type employed on tramway and light railway work, as fitted on the Manx Electric Railway and Newport Corporation Tramways.

Messrs. Player & Mitchell showed the ratchets and the brake handles without which hand-brakes would be useless.

Messrs. The National Rail & Tramway Appliances Co. have gone in for reducing the scrap heap by designing renewable brake blocks for cars and trains. Fig. 40 will explain how they do it.

Motors.—The Brush Co. made a hit by the inclusion of two real live armature winders among their exhibits. They were not for sale, but from the way they worked we think it probable that more than one engineer and manufacturer asked for quotations.

After a short probationary period, during which they "designed" plausible imitations of American motors, the Brush Co. gradually settled down to original work in this line, and for some time past they have been turning out the quality of work which visitors saw being put into their standard "1,002" armatures.

Messrs. Bruce Peebles have not been so very long at street tramcar motor work, but no one would know it who looked at the two 30-h.p. "F" type motors, which were mounted on a truck at their stand. We have never seen better designed tramcar motors, and the makers have every justification for saying that "they are designed in accordance with the best modern practice in all details and have a notably high efficiency." Prof. R. H. Smith makes a specially favourable reference to the Bruce Peebles direct current motor in his new book, "Electric Traction."

Messrs. Edgar Allen are better known to motor manufacturers than to the general tramway public as makers of steel motor-cases, and it surprised a good many visitors to see solid proofs of this

fact mixed up with points and crossings. They have made a special study of the manufacture of these cases in order to obtain the highest permeability consonant with strength.

Odds and Ends.—Messrs. W. S. Laycock & Co. and G. T. Peters were to the fore with an interesting variety of seats for cars and trains, those upholstered in rattan taking our fancy most as being

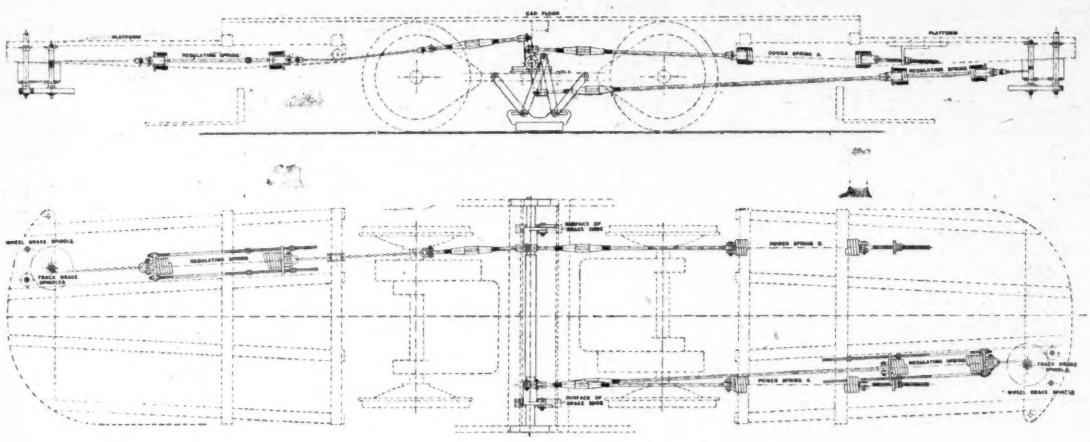


Fig. 39.—Freund's Patent Track Brake.

Controllers.—Owing to the absence of three of the makers, the list of controllers comes down to two, but there is the satisfaction of knowing that those two were made by the Brush Co. and Bruce Peebles, both British firms, and the further satisfaction that the

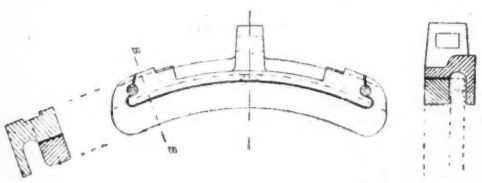


Fig. 40.—National Renewable Brake Blocks.

controllers are as good as any made by American or quasi-American firms. Fig. 41 shows the Brush 3A controller, opened.

Fig. 42 shows Messrs. Philipson & Co.'s patent life-saving system, the illustration having arrived too late for inclusion under their name on p. 84.

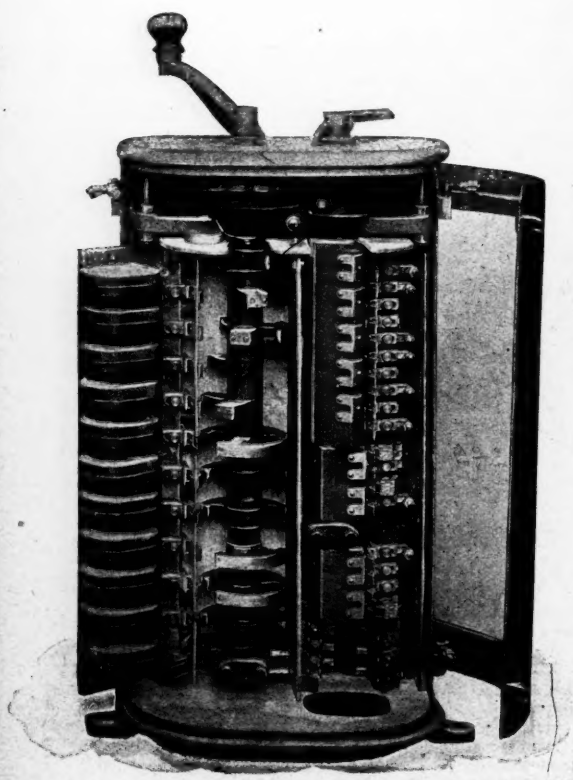


Fig. 41.—Brush Controller, Type 3A.

comfortable, hygienic and amenable to washing. These people also displayed blinds, curtains, ventilators, electric heaters (W. S. Laycock), linerusta-balanced window frames and sashes, &c.

Messrs. Player & Mitchell and the Wallace Supply Co. had stands filled with brass-work, lamp-fittings, gongs, and all manner of small fry without which something would be found wanting in a car.

Messrs. Knowles & Wollaston showed the "diamond" non-slip treads, and Messrs. Milnes, Voss had a useful article in "Hudson's" reversible step, the wearing surface of which lasts at least twice as long as that of any other, on account of the quality implied by its name.

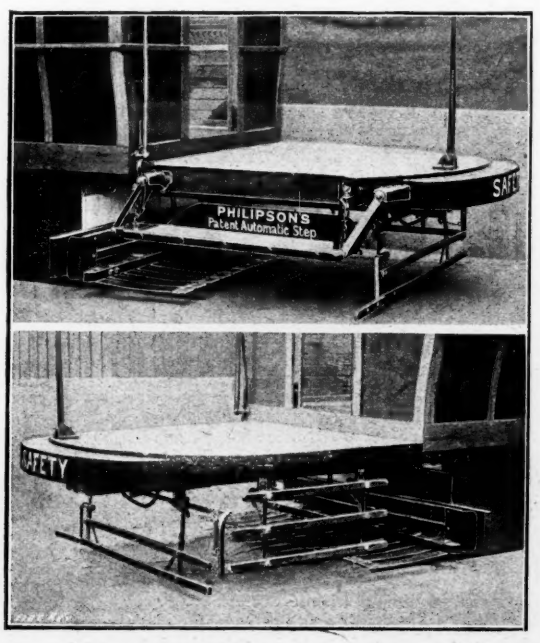


Fig. 42.—Philipson's Patent Lifeguard.

Messrs. Le Carbone made an interesting display out of uninteresting materials. We do not mean to suggest that the composition and attributes of a carbon brush have no interest to engineers, for that is manifestly not so, although we do think that the results of the careful and extensive researches of Messrs. Le Carbone, especially among brush makers, should be given something like the attention they merit.

The Fire-Resisting Corporation, Ltd., held a perpetual demonstration of the uninflammable nature of wood which had been impregnated throughout its fibre with fire-resisting crystals. This treatment prevents the spreading of flame, as the wood merely carbonises at the point of contact with fire. Obviously it is a safeguard against fire arising from short-circuits on trains and cars, or in buildings, and the whole of the wood used in the construction of 528 carriages for the Underground Electric Railways Co., of London, has been treated by this process. It has been adopted also by the Paris Underground Railway.

Overhead and Third Rail.—The most important advance in overhead construction which we have to chronicle is the tendency to use heavier trolley wire, of grooved or figure-8 section. We have foreshadowed and advocated this change in the columns of the Review for some years, and we feel now that few tramways will be constructed in future with circular section wire, or with wire less than the equivalent of 00 in sectional area. Even now 0000 wire is in use, and the days of No. 0 are already past. Perhaps the greatest advantage which the new sections have brought us is the ability to attach the wire to the ears and other fittings by purely

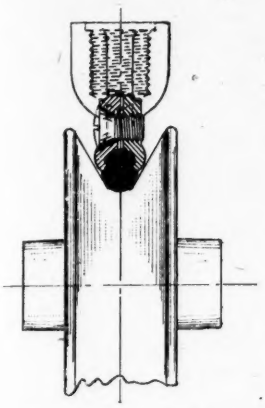


Fig. 43.—Cross-Section of Grooved Wire Suspension.

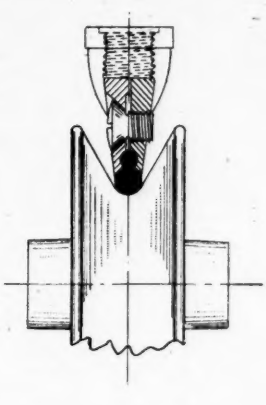


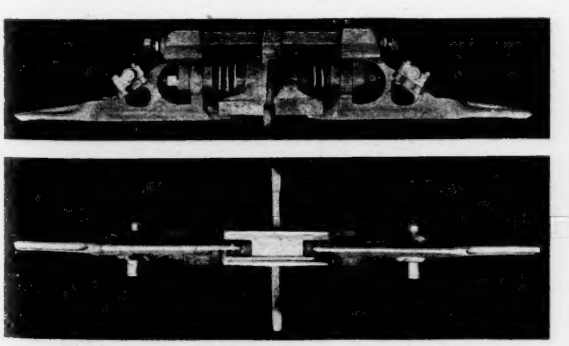
Fig. 44.—Cross-Section of Figure-8 Suspension.

mechanical means. So long as circular wire is used it will have to be attached by solder if the best results are to be obtained, and the disadvantages of this method are too well known to need recounting again.

It is with pleasure, therefore, that we hail the demand for sections which will make the work of construction, but especially of maintenance, vastly easier than hitherto, and will at one step lengthen the life of the overhead equipment by 50 if not by 100 per cent.

Fig. 45.—Diagonal *v.* Normal Air Gap.

Those who have had to do with the erection of figure 8 wire speak of it as more difficult to stretch properly than round wire, and it is an old tale that trouble has arisen from the wire turning over towards the middle of the span. We venture to think that figure-8 wire will be strung up as easily as circular wire of *the same section* when the linemen have gained the experience which is necessary for the efficient performance of any new work, and we



Figs. 46 and 47.—"Dirigo" Section Insulator.

know from personal observation that the twisting trouble can be avoided by careful work.

To all who have circular wire on their tramways, we would say that renewals can be made just as well with figure-8 as with round wire, so long as the lower bulb is rolled to the same, or nearly the same, radius as the original circle. Herewith will be found illustrations of composite fittings which have been designed for this purpose.

The only question that remains is the choice between grooved and figure-8 wire. With both mechanical ears can be used, but we are inclined to agree with Messrs. Brecknell, Munro and Rogers when they urge that with the grooved wire the total available clearance between the ear and the wheel is only enough to pass the wheel when new, but with a small amount of wear in the groove of the wheel or on the wire, the wheel flanges will rub the fitting, whereas the ear on a figure 8 wire is removed from this objectionable wear, no matter how much the trolley-wheel is worn. Figs. 43 and 44 illustrate this point clearly.

We suppose that no fitting has received so much attention at the hands of the inventor as the section insulator. It has been considered until quite recently as the weakest part of the equipment, and it has been every inventor's aim to produce something which starts by being mechanically as strong as any other fitting while performing its simple function of insulating as perfectly as possible one length of trolley-wire from another. Multiple air-gap section insulators have been designed to reduce the

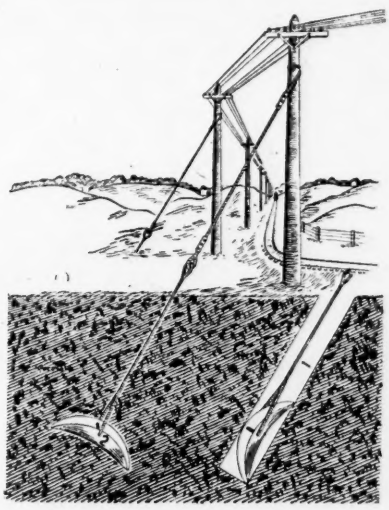
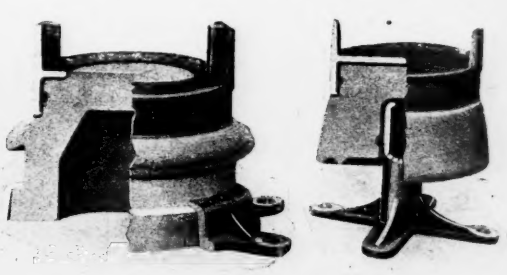


Fig. 48.—Miller Guy Anchor.

sparking which is sure to take place at times, and they have been more or less effective, especially since the gaps have been made diagonally, so that the path of the trolley-wheel is never interrupted, as it was when they were placed at right angles to the wire. The accompanying diagrams (fig. 45) illustrate our meaning.

We were more disappointed than surprised to find no examples of porcelain insulators for tramway work in the Exhibition (we are open to correction on this point), and would suggest to the makers of globe strains, turn-buckles and Brooklyn strains that a demand is arising in spite of them for glazed porcelain to replace these relatively costly articles.

Nobody paid much attention to third-rail insulation at the time of the last exhibition, being inclined to use the ready-made forms of insulation which had vogue in America at the time, but this year there are so many miles running and projected that it was natural



Figs. 49 and 50.—British Electric Equipment Rail Insulators.

to expect to find a greater variety. We were particularly glad to observe that British work in this direction was well represented by that progressive and receptive firm Messrs. Doulton and Co.

There was a good show of insulators for high and extra high-tension transmission, a subject which is going to be of rapidly increasing importance as the education of the B. of T. and of consulting engineers proceeds.

The British Electric Equipment Co., British agents of the Ohio Brass Co., displayed a complete line of "Dirigo" insulators and standard overhead fittings, the most notable being the section insulator illustrated herewith (figs. 46 and 47). This combines the advantages of a double air-gap with continuous running, which is obtained by allowing the flanges of the trolley wheel to run on to the

overlapping guide-runner before the groove has left the end castings. The British Electric Equipment Co. consider it advantageous to bridge the gaps by a fuse which connects the centre casting to the end castings. This has the effect of making the line continuous until a fault appears on any half-mile section, when the wire on which it is, is cut out by the action of the fuses nearest to it on each insulator. In the event of a motorman running his car from either

Fig. 51.—Switch Panel after Isolating Faulty Line.

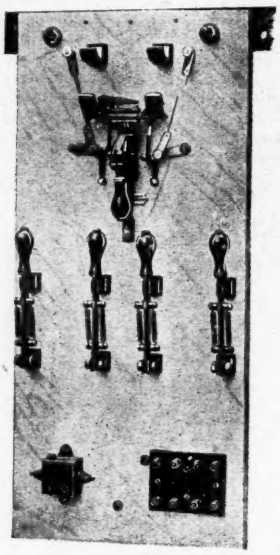


Fig. 52.—Cut-out Immediately after Operation.

side on to the earthed section, the outside fuse is blown and the faulty wire remains dead.

Fig. 48 shows the Miller guy anchor for aerial lines.

Experience in the design of third-rail insulators and the materials for their construction has had to be bought dearly, like most things in this cut-and-try world.

At first it was thought good to turn the retaining lugs on the cap casting over the flanges of the rail, but that was abandoned when breakages arose constantly from the struggle of the rail to be free. Then again no material could be found which would support a

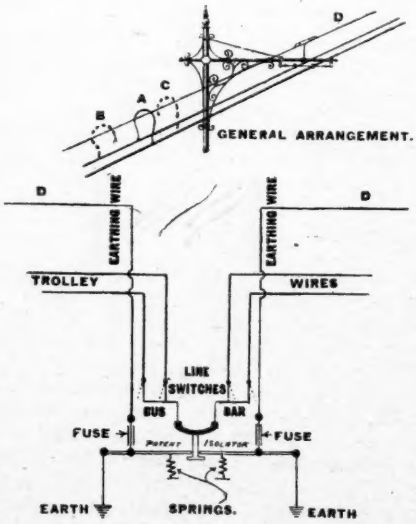


Fig. 53.—Berry & Risch Earthing Device: Diagram of Connections.

heavy section rail without breaking under traffic if the cap or the base were fixed by insertion into the body of the insulator. Rumour tells us, indeed, that the Underground Railways Co. have not been free from the troubles which spring from this design.

Fig. 49 explains how the British Electric Equipment Co. have overcome these troubles. It represents their Type B, Form 6 pattern, in which the retaining lugs are T-shaped to anchor the rail longitudinally and prevent it from "travelling" or "creeping." The insulating material is a composition called "semi-porcelain," having the high glaze which is essential, and any lateral strains on the malleable iron ring are transmitted uniformly to all sections of the insulator by means of the small inner flange at the lower edge of the ring casting which extends entirely around the insulator, and is embedded firmly in cement. Fig. 50 shows Type A, Form 5, which is intended for lighter service.

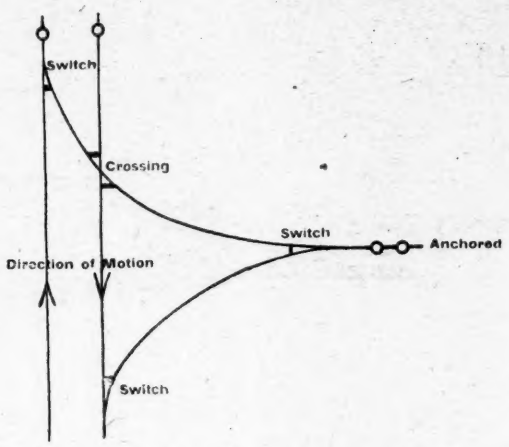
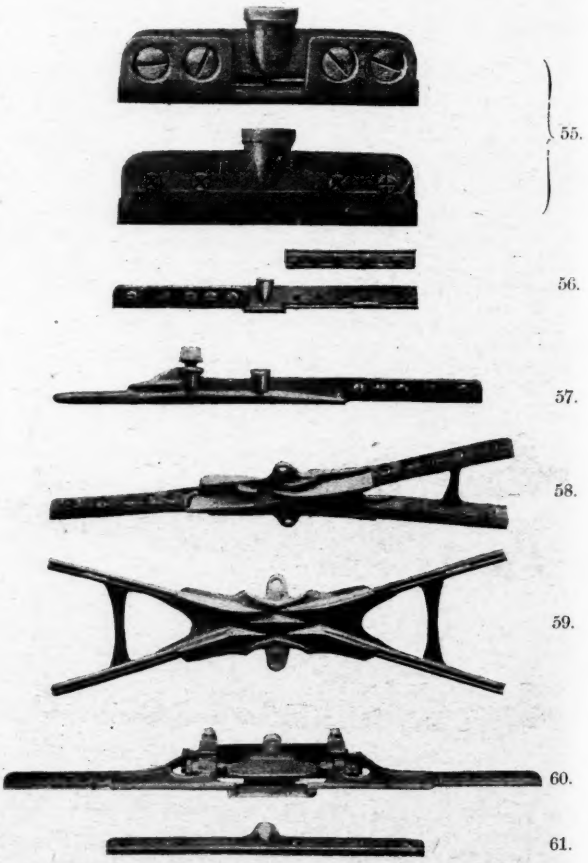


Fig. 54.—Ward's Patent Trolley Reverser.

Messrs. Berry, Skinner & Co. almost have a right to expect an apology for the slighting way in which we wrote of trolley earthing devices in general in our review of the Exhibition as a whole.

We went to their stand expecting to see some complex impracticable device after the style of those which plagued the owners of tramways some two years ago and before, and we came away filled



Figs. 55-61.—Various Ears, Frogs, &c., by Messrs. Brecknell, Munro & Rogers.

with pleasure at the knowledge that Mr. Berry had tackled the problem of preventing falling trolley and guard wires doing hurt to people and animals, in a manner which ought to put the tramway authorities themselves on his side. Ever since the adoption by one or two lines of the automatic cut-out system invented by the late

Mr. Quin, little or no pressure has been put on new or old undertakings to install anything of the sort, for practical acquaintance with the system put it out of the question. There be one or two in this land who could, an they would, fill several columns of this journal with chat about the Quin and other earthing devices, and they would not omit to mention the several hundreds of pounds per annum expended in energising the magnets of the cut-outs.

Without committing ourselves too much to a system which is on its trial in public streets for the first time at Walthamstow, we can say that none of the troubles peculiar to the Quin system, for instance, can afflict the Berry & Risch system.

In the first place, there is not an electro-magnet of the smallest size in it. The cut-out, which is charmingly quick and positive in its action, is tripped mechanically. Then it acts only when danger is about to arise, and so does away with the little boy on the top of every section pillar, of whom we have heard in connection with another device which tripped when the station circuit-breakers opened, and on other inconvenient pretexts.

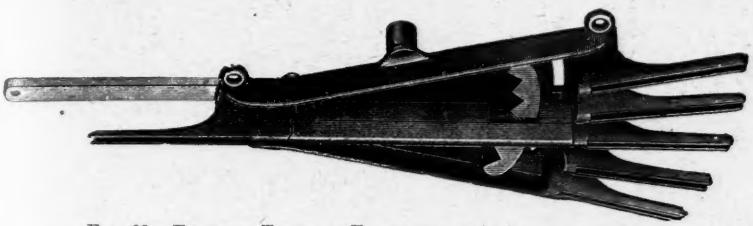


Fig. 62.—Electric Tramway Equipment Co.'s Car-shed Frog.

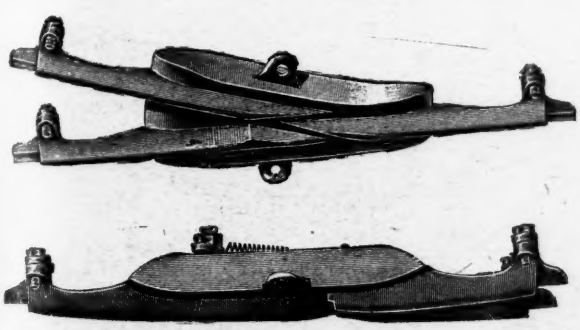
It will never cut out any section but the one affected, and, moreover, *it calls for one guard-wire only* over each trolley wire. That is its greatest triumph, and will appeal more than anything else to most of the people who have to maintain or pay for maintaining the existing double wiring.

"The installation at Walthamstow has been approved at a recent B. of T. inspection, when permission was granted for the same to be used under telephone wires instead of the usual system of guard wires" (*vide* pamphlet). That itself at once reduces the probability of trolley-wires falling by one-half at least.

Now let us see what manner of thing this is that has stirred us so much. Fig. 51 represents the switch-panel removed from a section-box. The cut-out is supposed to have acted (see the blown fuse), and to have been replaced after drawing the two right-hand switches controlling the section of overhead wires on which danger threatened. The corresponding fuse in the pillar at the other end of the section will have blown at the same instant as the one seen here, so the wires cannot be alive.

It matters not whether the broken wire be trolley, guard or message wire, the fuses will blow directly the guard wire is made alive.

Fig. 52 represents the cut-out just after it has acted, and fig. 53 gives the general arrangement and the diagram of connections. The loop A is attached to both wires, and encloses the guard wire D, which is connected to earth at each end of the section through a light fuse. We have the inventor's sanction for saying that when it is considered objectionable to connect the trolley wires in parallel by the loop A, two half loops B C may be attached, one to each trolley wire. It is the fuse that holds the cut-out in against a spring, and directly either fuse blows the cut-out falls, and the section is cut off from the bus-bars.



Figs. 63 and 64.—Fixed and Movable Frogs.

The following are a few of the advantages claimed by the patentees:—

The extra cost of installing the system is small, and it can be applied to existing tramways without troublesome alterations.

It localises a fault without opening the station breakers, and so reduces delays to a minimum.

It prevents message wires which have fallen across a live wire being burnt out.

It will no longer be necessary to go to the expense of placing message wires underground for the sake of safety.

It prevents damage being done to the trolley wire where contact is made with the fallen wire, and, we would add, where contact is made between trolley-poles and guard-wires, for in that way irretrievable damage is being done every day to wires all over the country.

Henceforth tramway undertakers need have no fear for their pockets when the Post Office or the B. of T. ask them to protect the public from falling wires.

Messrs. Brecknell, Munro & Rogers supplied much food for the mind at their stall. Ward's patent trolley reverser was strung up aloft with other automatic mysteries, so that one felt quite like being in some old necromancer's consulting room. This reverser is illustrated in fig. 54. We have seen it at work in several places, and we can assure our readers that the certainty of action obtained under Exhibition conditions is reproduced in the street. The advantages of a device of this nature, especially at busy termini, are too obvious to make further remarks necessary.

This firm have laid themselves out in anticipation of the demand for uncircular trolley wire, and the following illustrations will prove this:—Fig. 55 shows back and front views of a straight line for figure-8 wire. All ears, whether for straight line or curve work, are of similar design, and great attention has been paid to the cross-section of these fittings to ensure freedom for the wheel groove until the last. Fig. 56 shows a splicing ear for coupling two lengths of figure-8 wire, and discloses the ingenious method of taking the pull of the wire, the upper section of the wire being cut away to fit around a corresponding projection cast in the ear. When the half-clamp shown detached is screwed on the wire is held immovably. Fig. 57 is a composite splicing ear for coupling round section and figure-8 wires. Fig. 58 shows a frog with the arms fitted for figure-8, and the same method of attachment applies to all fittings. Figs. 59 and 60 show a crossing and section insulator for figure-8 wire, and fig. 61 is a photograph of an ear for grooved wire in which the bulbous form of which the drawbacks are seen in the section above (fig. 43) is apparent.

The stand of the Electric Tramway Equipment Co. contained everything in the way of overhead material that we could want, but as there was no striking novelty, we must be content to refer our readers to their excellent catalogue for everything except the subjects of the following illustrations:—Fig. 62 shows the multiple-way car-shed frog, which is already well known. Its great feature is the arrangement for locking the tongue, so that the trolley will take any desired road with certainty. When a lever on the indicator board, which may be fixed to the pole, is moved, pressure is exerted on the tongue, and the spring bolt is driven over the toothed quadrant until the desired point is reached. Figs. 63 and 64 are of a fixed and movable frog respectively.

(To be continued.)

A NEW CARBON FILAMENT.

Experiments connected with carbon filaments and the observation of the characteristic features of carbon resulting from different treatment are a peculiarly interesting study. A paper recording marked progress in the manufacture of carbon filaments has been presented to the American Institute of Electrical Engineers, at Ashville, N.C., June, 1905, by Mr. J. W. Howell, whose name has so long and so deservedly been before the electrical world. This paper is noticed at some length in the *Electrical Review* (New York) for July 8th.

Mr. Howell's experiments have evidently been conducted with much care and persistence, and he claims to have produced as a result, a carbon filament possessing new and important features, both scientific and commercial. The means employed for obtaining these results may be summarised under the title of high temperature baking or firing, the agent employed to effect the purpose being an electric furnace of the incandescent type, consisting of a carbon tube (having water-cooled copper connections) into which are passed cylindrical carbon boxes packed with filaments. To prevent combustion, the tube is embedded in powdered carbon.

Many investigators have worked on much the same lines, and have obtained some of the results described by Mr Howell. The adamantine carbon, born many years ago in the laboratories of Woodhouse & Rawson, was said to have been produced by means of the electric furnace, whilst the benefit of baking filaments at a high temperature, as in the oxyhydrogen furnace and the electric furnace, is a fact familiar to many. Mr. Howell has, however, proceeded a step further, as will be seen directly.

It is a well-known fact that a carbon filament heated

to exceptional temperatures by a current in an exhausted bulb, derives no benefit from the treatment, but it is otherwise when the filament is heated by external means to the highest attainable temperature at atmospheric pressures. The special point established in the paper in question is the markedly different effect which is produced when a so-called "treated" filament is "fired" by subjecting it to high temperatures in the electric furnace, as distinguished from the effect produced when a base filament, made from the usual squirted cellulose thread, is so subjected. By a treated filaf ment is, of course, meant one which has been heated electrically in hydro-carbon to produce an additional coat o-carbon. The ordinary base filament, whilst improved in some respects by the firing process, undergoes no very marked change in resistance, as is apparent by the curves in fig. 1, showing a fired and an ordinary carbonised filament run at different temperatures. As the temperature rises the resistance falls, but at different rates.

It is otherwise, however, with the fired treated filament. The resistance in this case becomes not only greatly reduced when cold, but is actually reversed as the temperature is increased, and rises, in fact, as with ordinary metals. From the curve of the fired shell in fig. 1 it will be seen to increase continuously from the start. By reason of this property the term "metallised filament" has been given to filaments

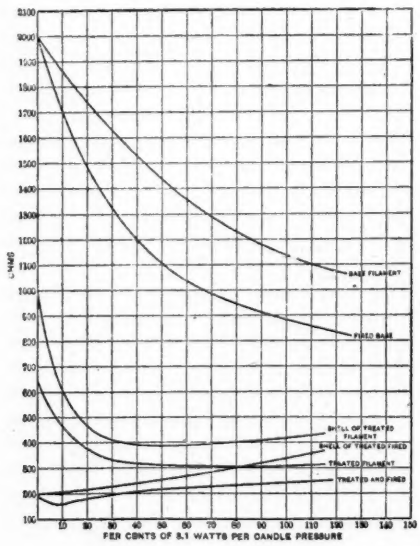


Fig. 1.—Resistance of Filaments at Different Temperatures.

which have undergone this treatment. The resistance of a fired treated filament depends upon the relative thickness of the base and of the deposited coat, and upon the temperature of the firing.

Curves 2 to 6 in fig. 2 indicate the resistance of treated filaments fired at different temperatures, Curve 1 showing that of an ordinary treated filament. The method of adjustment of the furnace temperature was by leaving open one end of the carbon tube containing the box of filaments, and by observing when the appearance of the inside corresponded in brightness with that of the filament of an ordinary lamp of 16 c.p. run at different pressures, the lamp being placed in the line of vision. The following table shows the point to which the temperature was carried :—

Curve 2.—The lamp was run at 153 per cent. of its normal pressure, and gave 125 candles.
Curve 3.—The lamp was run at 161 per cent. of its normal pressure, and gave 163 candles.
Curve 4.—The lamp was run at 183 per cent. of its normal pressure, and gave 230 candles.
Curve 5.—The lamp was run at 200 per cent. of its normal pressure, and gave 280 candles.

In Curve 6 the temperature was higher than 5, a temperature which, by Wanner's optical pyrometer, approached 3,700° C.

Fig. 3 shows the curve of a fired filament with a thin base and a thick deposit, after the manner of the once-familiar Cruto lamp. Here there is a remarkable increase of no less than 250 per cent. of the cold resistance when running at normal pressure.

That carbon deposited from hydro-carbons differs in many marked respects from ordinary carbon derived from organic matter such as cellulose is a perfectly familiar fact.

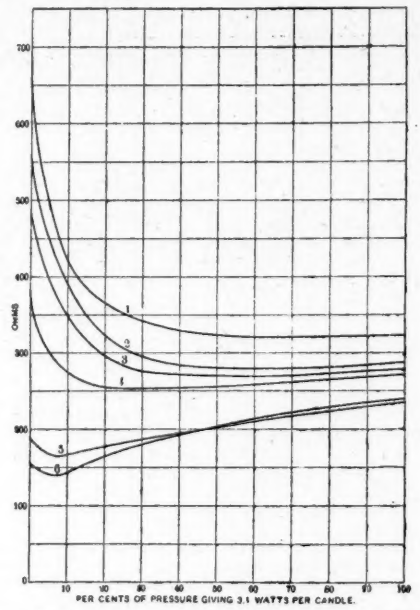


Fig. 2.—Resistance of Filaments Fired at Different Temperatures.

Instances of a rise of resistance of certain special filaments at high temperatures as the pressure was raised have, moreover, been noticed by some and probably many observers, and the cause has even been attributed to peculiarities of the carbon coat. It remained, however, for Mr. Howell to bring definitely to light some of the remarkable latent properties of this kind of carbon, and to explain at least in part to what they are due.

The explanation of the change from negative to positive resistance seems to be due, to some extent at any rate, to the

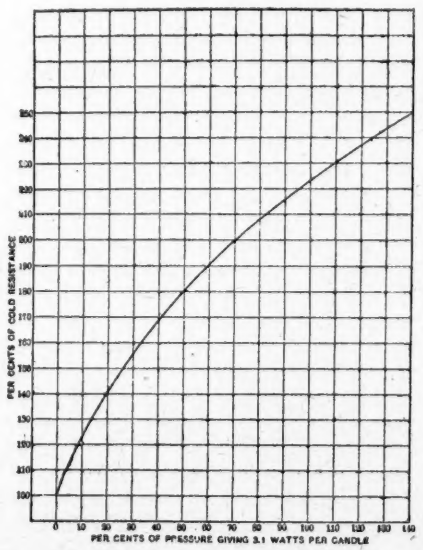


Fig. 3.—Filament of Thin Base, with Thick Deposit.

effect of the mineral matter, present in the base filament, on the deposited carbon ; since, when the base is preliminarily fired at different temperatures, the fact is disclosed that above a certain point the tendency of the finished fired filament to increase in resistance becomes much less pronounced. It has been ascertained that the base filament "loses practically all of its mineral ash constituents" by the pre-

liminary firing, and it has been further observed that if some of the elements contained in the original base be purposely placed in the furnace with treated filaments (whose bases have been previously fired) effects are produced similar to those observed when the bases had not been fired.

The appearance of a fired treated filament whose base has been preliminarily fired is, moreover, different from that of one which has not. In the former case it presents a slightly pebbled appearance and a rather dull grey colour; in the latter it is generally much blistered—an indication of an outflow of gas from the base when the shell was in a soft condition—and its surface is highly lustrous.

"The specific resistance of the highly heated coating has been found to be as low as 0·00006 ohm per cubic centimetre, which is very much lower than the specific resistance of any other known form of carbon or graphite.

"Its specific gravity is also much higher than it was before heating.

"Its changed nature is also indicated by its toughness and flexibility. The coating of a double-fired filament may be pulled off in short tubular sections, which, if pressed flat, will spring back to their original form when the pressure is removed. The same coating, before being fired, is comparatively brittle, and will break with very little pressure."

Tested by Berthelot's chemical method, the carbon coat, even of an unfired filament, proves to be graphite by the formation of graphitic acid, but the reaction is still more marked after firing. Ordinary carbon, and presumably the base after firing, is dissolved by the reagents. The fired coat has the greasy feel of graphite, and gives the characteristic mark on paper.

"Bamboo, coated by dipping in a solution of asphalt, is altered by firing, the coating changing to graphite and giving the characteristic positive curve. Silk dipped in sugar solution also gives the same result."

By removing the shell of a metallised filament the resistance curve returns to that of the original fired base, whereas pieces of the shell about 1·5 in. long mounted in lamps give strongly the characteristic curve of a metallised filament, thus abundantly proving that the change is due to the coating and not to the base.

Metallised filaments blacken the lamp bulbs much less than ordinary filaments, a point of considerable economic importance. This may be due to the elimination of mineral and other matters from the base filament. What is of still greater commercial importance is the fact that metallised filaments are more stable at high temperatures; they give, it is claimed, a useful life of 500 hours' run at 2·5 watts per C.P., as compared with a similar life with lamps of the best ordinary type run at 3·1 watts per C.P. Further, owing to the rise that occurs in resistance as the temperature increases, the lamps should be especially well suited for use on circuits of varying pressure.

If these economic features are substantiated in practice, and the lamps are capable of being turned out to run fairly uniformly, there can be little doubt that the metallised filament has come to stay, in spite of its increased cost of manufacture, and Mr. Howell and his colleagues, who have assisted in the work, will have been instrumental in effecting a striking improvement in the carbon filament lamp.

Electrolytic Action on Water Mains.—The German Association of Gas and Water Engineers has under consideration the question of the destruction of underground pipes by electrolytic action brought about by the leakage currents from the returns of electric tramways, and at the recent annual meeting of the society Herr Lindley, of Frankfort-on-Maine, presented a report prepared by the committee. It appears that investigations have been made or are in progress at Elberfeld, Strasburg, Dresden, Leipzig, Hamburg, Ergurt, and Freiburg, Bavaria, the Strasburg experiments being the only tests which have been completed. The results have apparently not been disclosed, except to the council of the association and the town interested. It is proposed to continue the investigation also in towns where electric tramways do not exist, but where the condition of the ground leads to the supposition that chemical or electro-chemical action is playing upon the underground pipes. It is hoped in this way to obtain further information on the question of earth currents. The object of the inquiry in general is to discover means for reducing to a minimum the danger of leakage currents from the return path of the circuit of tramways, and it is said that the measures suggested for this purpose will not increase the expenditure

CORRESPONDENCE.

Letters received after first post on Wednesday morning cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

How can I become a Commercial Engineer?

The reporter would have made a good commercial engineer had he received an engineering training.

"Coulomb" appears to have commenced at the right end; it now only remains for him to get an appointment as a tea salesman, but judging from his "wordy" letter, I am doubtful of his success.

The way to assist the Empire is to assist oneself, and the way to get hold of a good salary is to see that you are worth it, and take pains to possess such qualifications as to be able to command it, and, above all, to use that great gift—

Common Sense.

The following is a good recipe:—Take a trip to the Continent, preferably Germany; pick out all the firms who are not yet represented in Queen Victoria Street and Upper Thames Street. Rub in well with your credentials and press until you have secured the agencies of the best, by judicious playing off. Now take a small back top office in the City, and mix well together, being careful to pay no income-tax. Stir for several years in a perfectly scrupulous manner, making what you can when you have found out how the German does it. By the end of that time you will be a commercial engineer; the exact moment may be determined when you purchase a motor-car, or commence to cry out loudly for protection (if that consummation has not been reached) from others who are doing even as you did. *You* may also have relegated most of your work to a large staff, to whose loyalty you appeal once a year when you increase (or reduce) their salaries—contenting yourself with interviewing out-of-work engineers "who have been discharged from good positions," by firms who share the profits with their staff in fat years but decline to share the losses with them in lean years.

Several other ingredients are necessary, but these are trade secrets and are only discovered by experience.

Farad.

Political Blackmail.

I am not a telegraphist, nor am I in any way connected with the Postal Service.

In my previous letter I ventured to take you to task for saying that the servants of the State had no right to use their votes to secure an increase of wages.

You now appear willing to concede this point, and quite justly confirm my statement that the interests of the nation are sufficiently safeguarded by the rest of the voters.

It is neither relevant nor fair to cast the imputation of greed upon men in order to rob them of their right to representation, and this is what you were attempting to do.

I am contending for the principle of representation, and I decline to be drawn into the discussion of particular grievances.

We are very far yet from an equitable division of the proceeds of industry, and until working men take up their responsibility and use their votes to that end, we are likely to remain so.

The conventional idea that men should not vote upon matters in which they have an interest, arises from the unjust restriction of power to the few; and where all have an equal voice, there is properly balanced control, and no interest need be excluded. Indeed, the absurdity of being refused a vote in regard to the very things we most desire to vote upon, is perfectly obvious to the honest mind—such as I should wish to attribute to the Editors of this journal.

We are familiar with the argument that the slave is not fit for freedom. The only way to make him so is to give him freedom. When working men elect their own managers we shall begin to achieve justice. I trust that I have said enough to remove your objections to that consummation.

I cannot regard this as a trespass upon your space, for the issue is of vital importance, and it is greatly to be regretted that you should not have stood without hesitation for liberty and equity.

T. H. Ferris.

Leeds, *August 4th*, 1905.

I note that Mr. Ferris complains because you hold the view that he and his friends in the Post Office get as much pay as they are worth. If you will permit me I beg to agree with you. Our late Queen Victoria expressed the desire that the ranks of the telegraphists, lady clerks, &c., should be filled by the sons and daughters of the working classes. I wonder how many of the holders of these positions to-day would care to consider themselves as being related to this class of people. I think your comparisons were entirely in place. As regards technical knowledge, I venture to say that very few telegraphists can compare favourably with many of the men in the branch of railway work to which I belong—viz., the electric light and power branch of the Midland Railway Co., several having obtained honours certificates in electric light and power, and yet see how shamefully this branch has been treated by the officials of the locomotive department on its being taken over by them ; hours raised from 54 per week to 60 per week ; apparently unavoidably obliged to work two Sundays out of every three, and yet to have the previously allowed payment for the annual week's holiday stopped. If Post Office employés were treated in this way they might be justified in complaining.

P. H. W.

Electrical Engineering Extraordinary in South Africa.

I had expected that the letter under the above heading appearing in your issue of the 28th ult. would have called forth a reply from an abler pen than mine in your last issue.

Whatever is Mr. Clifford Jones grumbling about? Surely the same economic laws govern things electrical in South Africa as in any other portion of the British Empire, or the world for the matter of that. If the firms of "good standing" referred to do not find that it pays them to send "satellites" to interview the "Pioneers of the Electrical Empire" and others in South Africa, they will soon cease to do so, it is simply a question of business and the survival of the fittest.

Mr. Jones is hardly consistent in his letter. He first of all tells us that jobs in his territory have to be carried out "on the cheap," as far as first cost is concerned, even although it may cost more to run the station afterwards owing to the absence of such luxuries as proper draught for the boiler furnaces (produced by suitable smoke stacks), superheaters, and feed-water heaters. He then goes on to tell us a little story about a certain ignorant "satellite" who, by the way, does not appear to have been trying after orders for cables, but was probably selling lubricating oil or dynamo brushes, but who actually advised a small supply company with two existing generating stations to go on running them instead of scrapping one and spending a large amount on cables.

It almost looks as though Mr. Jones is trying to blow hot and cold with the same breath.

One Who Knows the Facts of the Case.

Some Arithmetical Questions for Mr. Byng.

I should like to propose one or two thoughts suggested by Mr. W. Pollard Digby's letter under the above heading in your issue of the 4th inst.

In the first place, a variant of the time honoured financial problem : If a herring and a half cost three-halfpence, how much would 240,000 cost ?

The answer is not £1,000.

May I suggest to Mr. Digby that a sound grasp of the principles of the rule of three is not, in itself, sufficient intellectual equipment for the conduct of a large industrial organisation.

Do you remember Mr. Pinero's definition of a financier ?

G. J. Lemmens.

87, Victoria Street, S.W.,
August 5th, 1905.

May I amend the wording of my fifth question in my letter of July 29th ? The concluding words should have been, "to say nothing of the fact that the surplus on wages alone is £1,265."

While this correction materially alters the wording of that sentence, it does not in any way vitiate the obvious conclusion, that, under all the circumstances narrated, if 2,000 men were employed for the manufacture of goods worth £13,265, this would only involve serious loss.

W. Pollard Digby.

London, W.C., *August 4th*, 1905.

Name Wanted.—A correspondent wants the address of the makers or agents for Kennedy's patent tube-bending machine.

REVIEWS.

Gleichstromerzeuger und Motoren : ihre Wirkungsweise, Berechnung und Konstruktion. By W. Winkelmann. Hanover : Gebrüder Jänecke. 1905. Price M. 3.40.

This little book forms the third volume of Königswerther's "Repetitorien der Elektrotechnik," and, like the rest of these volumes (some of which have previously been noticed in these columns), it is intended simply as a summary of the more generally accepted views on the subject dealt with.

It in no way competes with the ordinary text-book—in fact, such books as Arnold's and Kapp's on direct-current machinery are constantly referred to—but gives a connected account of up-to-date rules and methods of design, together with a minimum of explanatory matter. By itself the book would, therefore, not be of much service either to the beginner or to the experienced designer, but as a guide to the advanced technical college student in his reading it may, as stated in the preface, prove of considerable use.

The subject is dealt with under three headings :—(1) General principles governing design ; (2) the methods of applying these principles ; and (3) the detailed working out of a numerical example consisting of a standard four-pole 25-kw. dynamo.

The information given is accurate, though a little indefinite in parts, owing to the insertion, without critical comparison, of more or less contradictory rules given by different authorities in reference to one and the same point in design—*e.g.*, the determination of the iron losses and of the temperature rise in armatures. This difficulty can, however, usually be got over by the help of the numerous references given to more complete treatises. A short tabulated list of references to the chief articles on dynamo design in the German, English, French and American technical Press during the last 10 years is also given, but might, with advantage, have been made much more complete. The book is sufficiently indexed, and all the symbols employed are conveniently collected in a table at the end.

"N"-Rays. By R. Blondlot. Translated by J. Garcin. London : Longmans, Green & Co. 1905. Price 3s. 6d. net.

This is a collection of papers on "N"-rays, admirably translated into English, which have been communicated from

time to time by Prof. Blondlot, the discoverer of the rays, to the French Academy of Sciences. Under ordinary circumstances, the publication of a book on any newly-discovered scientific phenomenon in the early days of its investigation, before its exact relationship to cognate facts or hypotheses has been determined, is to be greatly deprecated. But the circumstances here are most exceptional, insomuch as the very objective *existence* of the "N"-rays has been denied by competent observers like R. W. Woods, Rubens and Lummel, Schenk, McKendrick, Campbell-Swinton and others, so that it is very desirable to be able to trace, in their author's own words, the story of these alleged remarkable discoveries. The "N"-rays are emitted by incandescent gas mantles, by Nernst lamps, by bricks, flints, &c., that have been exposed to sunlight, by bent canes, files, tempered knife blades (even one from a Roman tomb!), and, in general, from metals and other bodies that have been subjected to some state of molecular strain, and finally from the nerves and muscles of living organisms. The rays have the property of increasing the luminosity of faint sources of light, and of increasing, though not exciting, the emissivity of feebly-phosphorescent surfaces, and it is the latter quality, in particular, that has been utilised in the investigation of their properties. Most remarkable of all, they are said to excite in the eye itself an increased sensitiveness of vision for feebly-illuminated objects. The rays can be reflected, refracted and polarised, and their wave-length is supposed to be from 50 to 100 times shorter than that of yellow light. Such, in brief outline, are the properties of M. Blondlot's "N"-rays. Into the fascinating controversy as to whether they exist objectively or whether, as Lummel and Woods suggest, they are merely subjective and physiological, we cannot here enter; the question must still be considered as being *subjudice*. But it should be mentioned, first, that the effect of the rays on a phosphorescent screen has been recorded photographically (p. 66) in such a convincing fashion as to leave little room for doubt as to objective reality; and secondly, M. Blondlot has been careful to warn observers "that it is *indispensable* in these experiments to avoid all strain on the eye. . . . . The observer must play an absolutely passive part under penalty of seeing nothing. . . . . No attempt at an accommodation must be made. . . . . To attain this requires some practice, and is not an easy task. Some people, in fact, never succeed." More recently Mr. F. E. Hackett, in a communication to the Royal Dublin Society, and M. Blondlot himself have indicated ingenious quantitative methods for observing "N"-rays which should lead to unanimity on this vexed question; in the meantime, the publication of Blondlot's papers is most opportune, and it will have well served its purpose if it stimulates more interest in the subject on the part of English physicists than has up to the present been evinced.

A phosphorescent screen forms a useful frontispiece to the book.

Radium, and all about it. By S. R. Bottone. London: Whittaker & Co. 1905. Second edition, revised. Price 1s. net.

Radium is a mysterious substance, of which even to-day we know nothing definite. We are not sure whether it answers the chemist's existing definition of an "element" or not. Only one of the properties it exhibits when more or less imperfectly separated from the materials accompanying it in nature has been deeply investigated, for hitherto only that one property has seemed worthy of special attention. And yet that property has the effect of setting many of our leading men of science by the ears, for the doctrines of the conservation of energy and the immutability of matter appear to be called in question by it. Members of the general public are presumably not at all interested in such matters, but for some reason or other their imagination has been caught by radium, and they want to read about it. Mr. Bottone's little volume has, no doubt, been prepared to answer their demand, not to form a text-book; for the author (or the publisher) who issues a book containing "all about" a subject of which we know so very little, can hardly expect to be taken quite seriously by the technical reader.

Judged from this standpoint, Mr. Bottone has succeeded in his aim, especially in his earlier pages. He has included some reference to nearly all the experiments which have been made, and he seems to have described those experiments, and to have indicated their meaning, as simply as possible in his own words. Later on, however, by quoting or paraphrasing many of the investigators into the properties of radium, he has repeated himself a good deal; and he has used certain non-technical periodicals somewhat freely as sources of original information. In his last chapter, entitled "Theoretical Considerations," a more serious blemish occurs, for in paragraph 26 Mr. Bottone has adopted a method of writing which leaves us in doubt more than once whether he is giving us his own views or those of others. Sir William and Lady Huggins and M. Berthelot have been left least protected with the inverted commas or other safeguards that are their due; while, on page 88, reference is made to a grain of musk which has been radio-active for 40 years, but whose lawful ownership is beyond our comprehension.

Telegraphy. By Sir W. H. Preece, K.C.B., F.R.S., and Sir J. Sivewright, M.A., K.C.M.G. Eighteenth Impression. New Edition. London: Longmans, Green and Co. 1905. Price 7s. 6d.

This work shows no apparent sign of losing popularity, and although the authors have, to some extent, necessarily lost touch with the subject as it was originally introduced, *i.e.*, telegraphy from a Post Office point of view, yet the information given has, to a fair extent, been brought up to date in regard to Post Office apparatus, whilst the addition of such matter as "wireless telegraphy," "paper-core cables," and an extension of the subject of submarine telegraphy, has added to the value of the book. In so far as completeness is concerned, it may be mentioned that the British standards for copper conductors, adopted last year, have been introduced.

In the chapter on batteries the brief and bare reference to "Dry Batteries" seems hardly sufficient; the description of the almost-forgotten Grove and Bunsen cells (which have practically nothing to do with telegraphy) might with advantage have been omitted to make room for a detailed description of some form or forms of dry cells. Something more about the use of "Secondary Batteries" in telegraphy is very desirable in the book, seeing that these have entirely superseded "primaries" in all offices of any size. In fact, "Batteries" may distinctly be said to be lacking in modernity. In the chapter dealing with the Wheatstone A B C instrument, the long obsolete uninduced form is still to be seen, whilst nothing is said of the most recent form of transmitter with a Siemens armature, though this has been in use for some years.

On the other hand, the Steljes type printer is appropriately described. The ingenious "Murray" printing telegraph, which is in course of introduction into the Post Office, is dealt with briefly, but clearly; more is likely to be heard of this apparatus in the future. In Chapter XI. the recently introduced telegraph switching system is fully described; this system is doing valuable work. The telephone chapters do not strike one as being particularly up to date, but the rapid advance of telephone work, and the continual changes made in the forms and systems of apparatus, make it extremely difficult to keep pace with the growth of the same where literature is concerned. Valuable as "Preece and Sivewright's Telegraphy" undoubtedly is, as an exponent of modern practice we are afraid it is getting a little ancient; but the task of correcting this is an extremely difficult one.

Die Asynchronen Drehstrommotoren, ihre Wirkungsweise, Prüfung und Berechnung. By Dr. G. Benischke. (Vol. V. of "Elektrotechnik in Einzel-Darstellungen.") Price M.5 p.50.

Athough there would hardly seem to be any call for another book (especially in German) on the induction motor, such a series as the "Elektrotechnik in Einzel-Darstellungen" would be incomplete without some treatment of the subject, so that a certain justification exists in this case. At the same time it helps to fill a gap between

the very generalised treatment of Behrend's little book and the somewhat involved, though more complete, treatment of Heubach's recent book, "Der Drehstrommotor."

In order to save space a knowledge of the first principles of alternating current work is assumed, and frequent references to a previous volume by the same writer ("Die Grundgesetze der Wechselstromtechnik") occur.

The use of the higher mathematics is successfully avoided throughout, and simple, analytical and graphic methods are selected instead. There is, however, a tendency to multiply equations without sufficiently explaining the results arrived at. This is especially the case when dealing with the Heyland diagram, the justification for which is allowed to rest too much on the mathematical proof, and too little on a physical conception of the action of the motor.

The great simplicity and accuracy of this diagram, as used by the designer, are also not sufficiently brought out.

The book does not profess to be a handbook of design, so that the marked absence of numerical examples (beyond the single 2-H.P. three-phase motor whose consideration runs right through) is more or less justified, but it detracts from the clearness in parts, and is the more to be regretted as the author has, obviously, a very full experimental knowledge of the subject.

The chapter on the practical arrangement of the stator and rotor windings is everything that could be wished, and amongst the other good points of the book are a full description of motor starting arrangements, a discussion of the somewhat neglected question of the effect of rotor hysteresis and eddy-currents on the torque of the motor, some useful hints on motor testing, including a novel method of the author's for arriving at the friction loss in an induction motor by measuring the slip at very light loads, and a section on the use of induction motors as generators, as brakes and in cascade connection.

The book will, in fact, be found to form a useful addition to any of the more comprehensive treatises on alternating-current work, even if it is not sufficiently complete to stand alone.

THE PREVENTION OF OVERHEAD ACCIDENTS.

By ROBERT N. TWEEDY.

Following the article in your issues of May 5th and 12th, it may interest some of your readers to know how the safety of the overhead equipment is guarded on one of the large Midland systems.

The earliest portions of the network were erected seven years ago, when the experience of constructional engineers was not so mature as it became later, and when half the appliances common to modern lines were not available. The trolley-wire was suspended rigidly from the bracket-arms, and was insulated therefrom by the hanger-bolt and a bit of red fibre. Insulated turn-buckles were used to attach span wires to poles, and other things were done which would be termed errors if they were specified now, but were accepted as good practice then.

Anyone who has had the misfortune to live with trolley wires, insulated as described above, will acknowledge that the fibre insulation is just a snare and a delusion; a delusion in that it is a good conductor under certain conditions, and a snare because it may test all right during the day and fail the same night. Double sleeves of vulcanite or ebonite are better, but are still treacherous. Some time ago the leader of a team of three horses was unfortunate enough to touch a "live" centre pole, and, stumbling into better contact still, was killed immediately. The chain traces put the other two in the circuit and they, too, fell without a struggle. That accident was directly due to the sudden failure of the fibre sleeves under a rigid hanger-clip after very bad weather which had continued for some days. The last time that insulator had been flashed by the inspecting linemen it was sound, and the nightly leakage tests gave no indication of a coming fault. At the very time the accident occurred the rigid suspensions on this line were being replaced by flexible suspensions and reliable double insulation, and it goes without saying that the change was made in double quick time after that unpleasant affair.

The leaderette in the Electrical Review of May 26th, 1905, throws discredit on the daily leakage test prescribed by the B. of T., and the experience just given would appear to add evidence in the same sense; but, far from disregarding these tests after the accident, every effort was put forth to make them more effective. It was felt that a large percentage of failures would never be made known in their incipient stage by means of the nightly test, but it was known that a certain—or rather an uncertain—percentage of failures, not only of insulators but also of section feeders, would be notified in this way, and it was determined to take every advantage of it. Most of the objections to a nightly test mentioned in the leaderette referred to above had been faced and overcome long before. The worst one, as usual, was that of the trolley poles being left on the wires at distant depôts, but by making the night-foreman or charge-hand at each depôt responsible for opening the depôt switch or circuit-breaker on receiving a prescribed signal or message, this trouble was quite neutralised.

One extensive portion of the system was tested on Sunday mornings only, as it included a battery sub-station three miles from the main power house which was left unattended, but connected to the line through a fuse between 11 p.m. and 6 a.m. every night. Obviously, therefore, no leakage test could be made at the main power house on that particular section.

As a matter of fact, no accident had ever occurred on this section, probably because the overhead construction was all span wire, and the double insulation thoroughly reliable, but a third shift was put on at the sub-station, consisting of a lad whose chief duty was to take the battery off the line on receiving a telephone message, or a flash signal, and to put it on again when the tests had been taken. This operation takes five minutes at the outside, and the remaining seven hours and 55 minutes of the lad's time, less meal times, is occupied in piece-work of a light nature.

Leakage tests of all lines are taken nightly from two main power stations, and the attendants or engine-drivers who take them have instructions to telephone to the assistant engineer who is responsible for the overhead work immediately the reading on any feeder exceeds $\frac{1}{10}$ ampere, after making sure that trolley poles or lamps are not causing it. The assistant then turns out with reluctance varying directly as the temperature and inversely as the number of hours he has slept, and goes not to bed again until the line is clear. When the high reading is due to a voltmeter which has been left across the line, or to some folly of that kind, all the seismographs in the neighbourhood go off the scale. Within the last 12 months at least two incipient failures have been detected and removed before traffic started next day. That sounds insignificant, but it is conceivable that both of those faults might have cost the company far more than the small amount which covers the extra vigilance entailed.

On an indifferently maintained line, calls on account of high tests will be more numerous than on a line which is covered at frequent and regular intervals by clever and conscientious linemen. Undoubtedly that particular brand of lineman first has to be caught, but he is not such a rare bird as many think.

When you come to think of it there is no part of a tramway, more than the overhead equipment, which requires a man with such attributes, for no other part—power station, cars, permanent way, even cables—is so inaccessible to the engineer. Not that any tramway engineer disdains to go up the tower wagon on occasion, but his inspections necessarily must be limited, both in time and space, to a small fraction of the total necessary. He has to depend, therefore, on the linemen for the most part, and they must be worthy of their trust or trouble will come.

There are lines in operation on which the pressure brought on the engineer to reduce the wages bill is so heavy that the nominal lineman is working in the shops for the greater part of his time. That may be a source of economy for a period limited by particular circumstances, but it never fails to prove disastrous, or, at least, extravagant in the long run. Very short lines with very easy services may do with a fractional lineman, and it is not wise to state a definite limit

beyond which one lineman, at least, ought to put in full time at his name-work.

In order that the overhead equipment shall be as nearly accessible as is possible under the slave-driven conditions of the engineer's life, a daily report should be received from each lineman, as is suggested in your previous articles, and particular importance should be attached to these reports being filled up in every detail and sent in punctually.

A sample daily report selected at random is shown below. This form is no more permanent than any other, but it is the outcome of much practical experience, and has risen from the ashes of several others. Both the work done and the work left undone are set out, and the time spent on any particular job, together with the material used, can be seen at any time without referring to time-sheets and requisitions or stores' ledgers.

LINEMAN'S DAILY REPORT. *No.* 769

These Sheets Must be Kept Clean. A Separate Sheet to be Used for Each Section.

Name H. Dudgeon. *Date* Dec. 16th, 1904. D. & S. *Section.*

Details of Work Done.	Hours spent on each job. From.	To.	Hours.	Route or job, No.	Account No.
Cut down and removed two spans, and 320 yds. guard wire. Replaced same with new wire, tied and bonded it, at Attwood and Jones, Stourbridge. Spliced in 10 ft. 7/18 cable in place of guard wire over trolley round Brettell Lane curve.	p.m. 11	a.m. 5	6	L_1	

Details of Material Used.	
70 ft. span wire (secondhand but good). guard wire, 10 ft. 7/18 cable.	280 yds.

Details of Material Removed *(State whether good or scrapped).*	Number of stores sheet
Two guard spans, and 280 ft. of guard wire—scrap. 40 yds. of good guard wire. Samples of the guard wire attached.	

Report of any Defect on which Work still has to be Done.

Time out a.m. 11 p.m. *to* 5 a.m. *Meal times* a.m. a.m. p.m. p.m. p.m. *Time worked* 6 *Horse hours* 11 p.m. *to* 5 a.m. *N.B.—Horse hours to count from time of leaving to time of returning to Depôt.*

Owner of horse, J. Wilde. *Certified by* T. S.

Noted by R. N. T., *Engineer.*

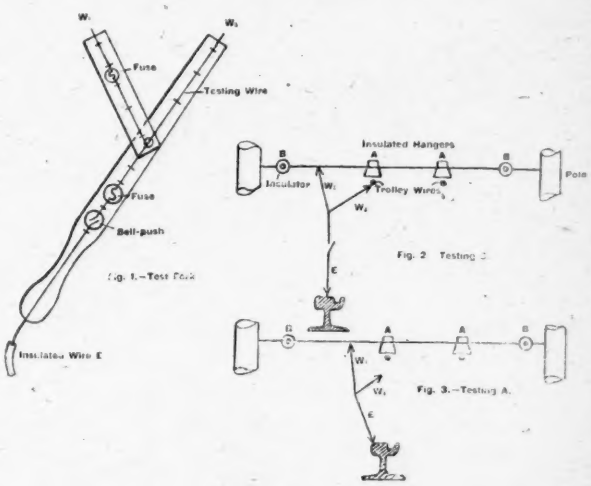
Besides the direct value to the department these details might chance to have a decided indirect or latent value. If a serious accident took place, notwithstanding the best efforts of the concern, the B. of T. or the coroner, or the judge, might have their opinions favourably affected by sight of a continuous and substantial record of the work done at the unlucky spot, and over the whole of the system. In order to render this still more effective it is advisable either to enter the number of the lineman's daily report against any entry of goods and wages in the ledgers, or the folio numbers of those ledgers on the report itself, so providing a verified reference to the cost of any work on the line.

While overhead maintenance and repair has a separate series of index or identification letters (*e.g.*, D R_3 = Repairs to trolley-wires and attachments), in the same way that car repairs or costs of generation have distinct series, every route has a distinguishing number (*e.g.*, L_5 = Kinver Light Railway), and the cost of maintaining every route is kept separately.

There is a special day for the inspection of every route, and nothing whatever, except an emergency call, is allowed to interfere with this inspection. The more populous routes or parts of routes are inspected in detail once a week—rain or shine—and the remainder once every 28 days. These inspections are thorough, and the linemen know that time is the least important object, so long as they use it properly; and they work in such conspicuous positions that a scamp is soon nailed.

All testing and inspection is done from the platform of a tower wagon, and as it is not feasible to lower the lineman or to raise the platform at every point of suspension of the wires, the man stays in his elevated position all the time. On this account it is essential that the horse be of a serious turn of mind, and that the driver be alive to his responsibilities. The most useful horse for inspection work is the animal that goes to sleep directly it is stopped. Under such conditions the driver can give the lineman a hand without troubling to unhitch the steed.

Every insulator is tested by flashing in the manner shown below. The driver holds the insulated wire E, and makes contact with the rails when the tower wagon stands under a span. This arrangement permits all the insulators on one span to be tested without moving the wagon. Either a voltmeter or a fuse is used, generally a fuse, and the testing apparatus is of the simplest construction, being made of two pieces of wood joined in the shape of a **Y**, with wire staples along the three legs and bits of fuse wire connected to the wires W_1, E and W_2, E. Supplies of the right size of fuse wire are carried on each wagon so that there can be no excuse for opening the station circuit-breakers when a fault



Testing Apparatus.

is disclosed. Placed conveniently on the handle of the fork is a bell push by which connection with rail is made at will. Of course, it would be possible to fix contact arrangements on the platform of the wagon and bring the connections to switches and voltmeter below, so that the lineman would not have to travel on the top, but visual inspection proceeds with the flash test, and for that the lineman must be on the platform.

The engineer sees every daily report and initials it after the mains engineer has passed it, and it is returned to the latter to be embodied in a weekly report which summarises under various headings the result of the week's work. The mains engineer keeps a private record of repairs outstanding as detailed on the lineman's reports, and cancels a job as soon as its completion is notified on a daily report.

These precautions have resulted in a pleasing immunity from accidents and emergency calls, although most of the lines are more than three years old, and some nearly seven, so that all the troubles due to age and light trolley wire are always awaiting the least relaxation of detective keenness to become active. The lineman carries a wire-gauge with which he takes frequently the size of the trolley wire at hard worked places, and directly a fixed limit gauge slips on, that length of wire is replaced. Sweated ears are used with circular wire, and as the wire is hammered and arcked away by the trolley wheels (as it is inevitably, sooner or later, wherever circular wire is used) the ear is removed carefully and replaced with a longer ear which well covers the worn parts. This can be continued until the ears become unwieldy, at which stage the length of wire is renewed.

Directly a report comes in that a trolley pole has de-wired and has opened a station circuit-breaker by fouling guard-wires, a lineman is sent to examine trolley and guard wires at the spot for burns, and to put in a splicing sleeve if the trolley wire is scarred at all. As reports of these accidents do not always find their way into the office, the inspecting lineman examines carefully not only the points of suspension but the whole length of wire in between, and many breaks which might have had serious consequences have been averted by care in this direction. Everything that can rust, or gather metallic and sooty particles from the air, is brushed or scraped, and painted, at least twice a year.

The linemen have charge of the section pillars, and see that they are kept clean and that there are spare fuses in each. Inspectors and motormen are encouraged to notify the office whenever they see something the matter with the overhead work, and lectures are given every week for the instruction of all employés who care to come, on the best methods of dealing with overhead troubles. On more than one occasion these lectures have borne good fruit, and have encouraged continued efforts in the direction of education.

PHYSICAL SOCIETY.

At the meeting held on June 16th, 1905, Prof. J. H. Poynting F.R.S., President, in the chair, a paper "On the Ratio Between the Mean Spherical and the Mean Horizontal Candle-Power of Incandescent Lamps" was read by Prof. Fleming. This paper contains a theoretical deduction from first principles of experimental results given by Mr. G. B. Dyke, B.Sc., in a paper read before the Physical Society on November 11th, 1904, respecting the ratio of the M.S.C.P. of incandescent electric lamps to the M.H.C.P. taken when the lamp was rotating round a vertical axis. In the case of nine different types of electric glow lamps, this ratio was found to be a number near 0·78. The author shows, by discussing the simple case of a linear filament, that the ratio of the M.S.C.P. to the horizontal candle-power for this last case must be represented by the value $\pi/4 = 0{\cdot}785$, and hence that the constant ratio found experimentally by Mr. Dyke necessarily follows as a simple consequence of the fact that the light sent out in any direction from each unit of length of an incandescent filament varies as the cosine of the angle of inclination of the ray to the normal to the filament. In the paper it is shown also how a simple correcting factor may be obtained for reducing the actual horizontal candle-power of a linear filament of finite length to the candle-power in the same direction which would be found if the elements of the filament were concentrated on the axis of the photometer and all normal to it.

Mr. G. B. Dyke briefly described the experiments which had been performed to justify the law.

Prof. J. A. Fleming said he had tried to impress upon lamp users the advantages of expressing candle-power in terms of the total flux of light per watt consumed. Now that a simple relation had been established between M.S.C.P. and M.H.C.P, there was no excuse for expressing the candle-power of a lamp as its maximum horizontal candle-power.

Dr. H. A. Wilson read a paper on "The Electrical Conductivity of Flames." The paper contains an account of a series of experiments on the conductivity of a coal-gas flame for electricity between platinum electrodes immersed in the flame.

Dr. Wilson said that the salts of cæsium, rubidium, potassium, sodium and lithium imparted conductivity to flames in the order named. This order was also the order of the atomic weights. He had found that a flame could be used as a rectifier when using alternations of about 100 cycles per second, but was not sure whether it would rectify rapidly alternating currents.

A paper on "Contact with Dielectrics" was read by Mr. Rollo Appleyard. Among the conclusions arrived at were the following:—Except in the case of homogeneous dielectrics, it is misleading to deduce specific values referred to unit cube of the material, from the results of tests on sheets. With tin-foil electrodes, the apparent resistance of press-spahn diminishes as the load increases, and it attains a fairly constant value at a load of 400 grammes per cm.²

For small loads, with tin-foil electrodes, the second-minute deflection is in general greater than the first-minute deflection. As the load increases, a point is reached at which these deflections become approximately equal. For loads greater than about 360 grammes per cm², the first-minute deflection is in general greater than the second-minute deflection.

Increase of voltage, with tin-foil electrodes, especially with small loads, behaves like increase of load, apparently increasing the contact area, and diminishing the observed dielectric resistance. Load, voltage, and the normal effect of "absorption" thus combine to determine the ratio of the first-minute deflection to the second-minute deflection.

When mercury electrodes are used, the dielectric resistance, as measured at different voltages, is sensibly the same, even for abrupt and great changes of voltage.

When mercury electrodes are used, the second-minute deflection is in general never greater than the first-minute deflection. The inference is that when, with tin-foil electrodes, the converse is the case, it arises from imperfect contact, and not from the material itself.

When mercury electrodes are used, the dielectric resistance, as measured with a voltage applied in a given direction, is sensibly the same as that measured with the voltage reversed, and this equality appears to become greater after a few reversals.

There is a critical load at which tin-foil electrodes yield fairly accurate results. With greater loads, there is danger of crushing the material. With a less load the contact is faulty.

Mr. David Owen, in reference to the variation of apparent resistance with the volts applied in the case of the experiments made by the author where tin-foil electrodes were used, pointed out that an effect of the same kind takes place in the case of the leakage resistance of condensers of paraffined paper and tin-foil.

Mr. A. Campbell said Mr. Appleyard had established the advantages of mercury electrodes. Mr Campbell had used tin-foil and indiarubber electrodes for the last 15 years, and mentioned that before they were adopted at the National Physical Laboratory for Mr. Rayner's and other work, they were put through a series of tests with varying weights, and from the observations a working pressure was chosen which gave tolerably accurate results. He had also tried guard-wires with several kinds of sheets, and found that the surface leakage was negligible. When measuring the capacities of thin sheets, tin-foil electrodes gave results which in some cases varied with the applied pressure. For example, with dry paper as dielectric, increase of pressure gave considerable increase of capacity, and since in this case the contact does not matter, the effect must have been due to approach of the electrodes. If the paper be black-leaded the change of pressure has less effect. He therefore suggested that in cases where mercury was inconvenient, the use of black-lead might be of advantage.

The following papers were taken as read:—"The Pendulum Accelerometer; an Instrument for the Direct Measurement and Recording of Acceleration," by Mr. F. Lanchester. "A New Form of Pyknometer," by Mr. N. V. Stanford.

Mr. Rollo Appleyard exhibited a "Refractometer" for the determination of refractive indices, which can be used as an ordinary spectrometer, as an Abbe refractometer, or as a Pulfrich refractometer.

At the closing meeting held on June 30th, Dr. R. T. Glazebrook, F.R.S., in the chair, a paper on "The Comparison of Electric Fields by means of an Oscillating Electric Needle" was read by Mr. D. Owen. This paper describes experiments which show how an "electric needle" may be used to measure electric fields in a manner similar to that in which a magnetic field is measured by an oscillating magnetic needle. The needles used were cylindrical in form, of aluminium or of brass, and were suspended by quartz fibres 3 or 4 in. in length. They may be used in alternating as well as in steady fields, and may be applied to illustrate many of the laws of electrostatics. The shielding effect of some dielectric materials was examined with a needle suspended centrally in the uniform field between a pair of parallel plates. The paper concludes by pointing out that an electric needle suspended between a pair of parallel plates forms a simple means of measuring high voltages, since the frequency of vibration is simply proportional to the voltage between the plates.

Prof. R. W. Wood read a paper on "The Magneto-Optics of Sodium Vapour and the Rotatory Dispersion Formula." The paper describes the phenomena which are presented when sodium vapour is formed in the magnetic field. In the case of very dense vapours the rotation has been measured over a considerable range of wave-lengths, namely, throughout the region comprised between $\lambda = 5{,}840$ and $\lambda = 5{,}922$. The paper concludes with an account of the bright line spectrum produced by magnetic rotation which presents itself when the Nicol's prisms of the apparatus are crossed.

Prof. R. W. Wood also read a paper on "The Fluorescence of Sodium Vapour."

BUSINESS NOTES.

Charge of Defrauding Electrical Firms.—Some of the daily papers have been publishing a good deal of information lately concerning certain electrical frauds which are said to have been going on in London for some time past. Some light as to the actual charges was thrown on the matter on 3rd inst. when Richard Rosenberg, 33, was charged at the Guildhall with conspiring to defraud Messrs. Strode & Co., electrical engineers, of St. Paul's Churchyard. Warrants had also been issued against Wm. Leslie and Frances Cheeseman in connection with the same charge. It is reported that the sums obtained from several prominent electrical firms amount to upwards of £20,000. Mr. R. Tweedie Smith—whose name is well known to most of our readers, he being the honorary solicitor of the London Electrical Contractors' Association—appeared for the prosecution, and the magistrate granted a remand until Wednesday last, August 9th. The matter was up at the Guildhall on that day, when George Webber, an ironmonger, of Putney, and Rosenberg, surrendered to their bail. Two other persons were mentioned in connection with the charge—Wm. Leslie, and a woman, Frances Cheeseman. It appeared that during May, June and July, they obtained many thousands of pounds in money and goods from electrical firms. Rosenberg posed as a "Mr. Knight" of a company called the "Electrical Accessories Co.," formed last November, which occupied a back room in Holborn. The full details of the methods adopted for obtaining money and goods appeared in the *Times* yesterday. Mr. Bodkin conducted the prosecution on Wednesday, and the prisoners were remarded on bail.

Disclaimer.—The Accessories Manufacturing Co., Ltd., of 9 and 10, Wells Street, Oxford Street, W., ask us to point out that they have no connection whatever with the Electrical Accessories Co., of Terminus Chambers, which is mentioned above.

Brooks's Motor Starter.—Mr. H. B. Brooks, of Granville Works, Tennant Street, Birmingham, is placing on the market a patent differential "Fool Proof" motor starting rheostat, which is designed to completely protect electric motors from damage, particularly the burning out of armatures by a too rapid operation of the ordinary starting switch by inexperienced or careless attendants. This device is simple both in construction and action. Fig. 1 shows the general appearance of the starter with cover removed, and fig. 2 is a diagram showing the mode of operation.

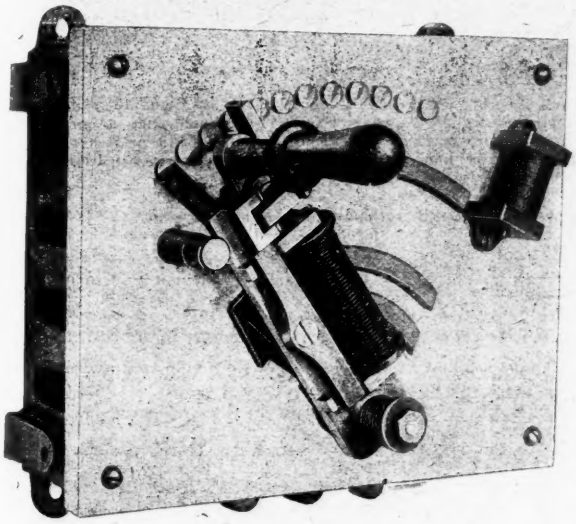


Fig. 1.—Brooks's Motor Starter, Cover Removed.

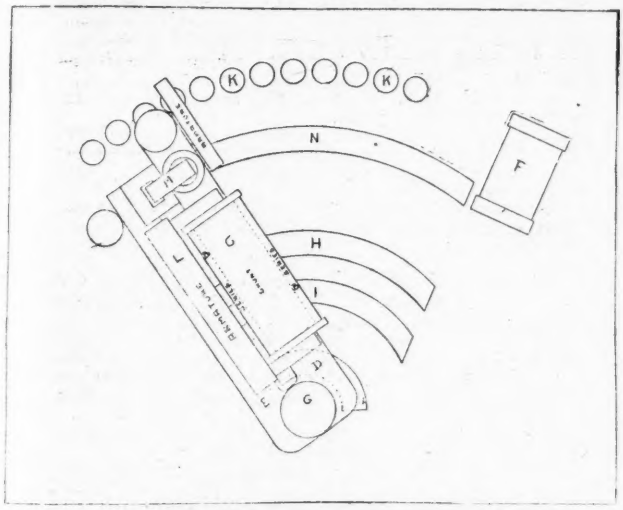


Fig. 2.—Diagram of Starter.

The switch has two levers, E and D respectively (see diagram), working on the same centre G. The lever D, viz., the coil lever, has upon it a fixed electro-magnet, wound with a coil C, which is arranged in series with the electro-magnet F, and in circuit with the shunt winding of the motor. Upon the coil C is placed a series winding B, working in opposition to the coil C. The winding B is connected in series with the main armature circuit. The lever E has an armature L fixed upon it which is attracted by the electro-magnet on the coil lever. On the lever E there are also fixed three brushes, two for the purpose of completing the shunt circuit of the motor, and one working over the resistance studs K carrying the motor armature current.

On the coil lever D is fastened a small catch M engaging with the armature lever E, and so arranged that when the lever D is pulled over by means of a handle, the catch M draws the armature lever also until it arrives at a position at which the shunt circuit of the motor is complete. After this point the catch M is raised by pressing on the inclined plane N; when this has occurred the armature lever E relies upon the magnetism of the electro-magnet on the coil lever D to draw it over to the last stud, where all the resistance is cut out, and where it is held by means of the usual no-voltage release electro-magnet.

If the operator switches on too quickly, the sudden rush of current which takes place in the winding D demagnetises the attracting magnet and releases the armature lever E, which then returns to the dead or original position, irrespective of the position of the lever D.

In case of the motor working under too heavy a load, the attracting magnet is again demagnetised, and the lever E is released and returns to its dead position, which disconnects the shunt circuit on the quadrants H and I (and in doing so allows the induced E.M.F. to die away across an auxiliary resistance); thus the electro-magnet F becomes demagnetised and the lever D returns to its off position.

In case of the shunt circuit being incomplete, the attracting magnet does not become magnetised, thus making it impossible to complete the armature circuit, as the catch M releases before the main brush reaches the first live contact stud.

The overload release (and also the advantages stated above) being independent of any short-circuiting devices, the trouble caused by corroded and dirty electrical contacts is avoided, and their reliable action is ensured.

Starting switches above 3 B.H.P. are fitted with a carbon break, and above 5 B.H.P. with renewable contacts.

Incandescent Lamps.—The European Electric Lamp Manufacturers' Syndicate, which includes all the leading makers of glow lamps on the Continent, has arranged for representation in this country by Mr. Martin Kaul, who, though not residing here permanently, pays frequent visits to London, his address being Holborn Viaduct Hotel. As is generally known, the syndicate was formed to keep up the quality and price of Continental lamps by preventing excessive competition.

Oil Feeder Contract.—Messrs. Joseph Kaye & Sons, Ltd., of Leeds and London, have received an order from H.M. Navy for 4,700 of their new patent serrated seamless oil feeders.

Electrical Developments in Valparaiso. — Mr. Rowley, H.M. Acting Consul-General for Chili, gives in his annual report for 1904 particulars of the works being carried out near Valparaiso by the Electric Light and Traction Co. These particulars are, on the whole, intelligible, although such expressions as "three-phased generators" and "compound superheating steam type engines," "each mounted on its own independent boiler," are somewhat irregular. The generating station will be about five miles north of Valparaiso, the water being brought through tunnels some 17,000 yds. in length from the reservoir to the 1,200-H.P. Pelton wheels which are to drive the 7,000-volt generators. Two separate and distinct overhead transmission lines take the current to Valparaiso to the sub-station, where rotary converters transform the three-phase current to continuous current at 500 to 600 volts. For provisional use pending the completion of the large power house, two 400-H.P. steam engines of the type and mounting mentioned have been installed at the sub-station. All cables, whether high or low tension, within the town, are laid underground, lead-covered, steel-armoured cables being used. When finished, the streets will be lit by 200 open arc lights of 2,000 C.P. mounted on steel poles placed 40 to 60 yds. apart. Some 700 Nernst lamps are to be used in the side streets, while for the outlying streets 1,000 25-C.P. incandescents will be used. As regards electric traction, 25 miles of track will be laid down, of which 10 will be for the inner part of the town, and the remainder for the suburbs. It is not stated whether the whole of this plant has been yet ordered, and nothing is said regarding the prospects of increasing the export trade in electrical machinery with Chili.

Royal Lancashire Agricultural Show.—Among the exhibits at the County Show held at Liverpool from Thursday to Monday last was an electric derrick crane, shown by Messrs. Rushworth Bros., Ltd., of Colne. The crane had a braced steel jib 70 ft. long, and was provided with a 12-B.H.P. "Aston" motor of Veritys' construction. Electricity for driving was generated at the stand of Crossley Bros., Ltd., which firm had on view a representative collection of engines, including two gas engines, one of 32 B.H.P., the other of 12½ B.H.P., for suction gas, with electric ignition, the smaller engine being combined with a dynamo for electric lighting. Three other gas engines for town gas, of 23, 14½ and 1½ B.H.P. respectively, were exhibited by this firm; also an oil engine of 4½ B.H.P., combined with a dynamo for electric lighting, an oil engine of 9½ B.H.P., a petrol engine of 24 B.H.P., and a small gas plant on the suction principle. Gas generating plants formed a feature of the show on the implement side, such being exhibited by the Campbell Gas Engine Co., Ltd.; the National Gas Engine Co. showed seven of their "National" gas engines, one small engine of 1¾ B.H.P. being provided with a dynamo suitable for 20 16-C.P. lamps, also a "National" oil engine of 2 B.H.P. Messrs. W. J. Bates & Co., Ltd., Denton, showed an "Industrial" suction gas producer, a 6-B.H.P. spirit engine, and a 3½-B.H.P. oil engine. Messrs. Tangyes, Ltd., Birmingham, exhibited a 29-H.P. Tangyes gas engine with suction gas producer plant. Mr. John Robson, Shipley, showed a 21½-B.H.P. "Nonpareil" suction gas engine and producer gas plant. An imposing exhibit by Merryweather & Sons, Ltd., included their "Hatfield" electric motor and pump; also an electric portable hand fire-pump, mounted on wheels, complete, with wires to be connected with house lighting fittings in the event of a fire occurring, to operate the pump. A Merryweather "Squire's engine," fitted with a dynamo, was included in the collection. The Alsop Flour Process, Ltd., 21, Mincing Lane, London, exhibited the Alsop electrical flour purifying apparatus. By this process, flour, it was said, could be purified "by a flash of lightning." A silver medal was awarded for the process.

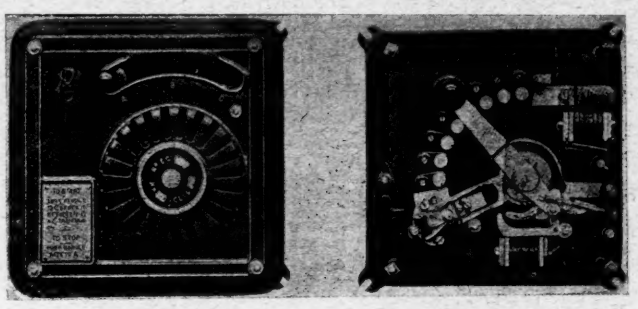
The Transvaal.—The value of the electric cable, wire and fittings imported into the Transvaal during the four months ending with April last is returned at £65,000, as compared with only £22,000 in the corresponding four months of 1904.

Trade Announcement.—Messrs. Dorman & Smith, of Salford, have appointed Messrs. Andrews, Davidsón & Co., 126, Bothwell Street, Glasgow, to represent them in Scotland for the sale of their switches, fuses, switchboards, electrical accessories and fittings.

Motor Starters.—We have received from Messrs. Bray, Markham & Reiss, Ltd., copies of their latest Starter price lists. Their "new" type starters of 5 H.P. and upwards are operated by means of a pawl and ratchet to prevent too rapid cutting out of the resistance. By an ingenious arrangement the contact arm is retained on each contact so long as the operating handle is held. Should it be released before all the resistance was cut out, or should an overload occur during switching-on, the contact arm would immediately return to the "off" position. A magnetic blow-out is fitted to the first contact, and duplicate renewable carbon buttons are provided on all the other contacts to take up the sparking.

The resistances are of the makers' well-known enamelled steel tubes, wound with non-corrosive high resistance wire, and can be removed from the switch in a few minutes for inspection or repair. All connections are mechanically made, without solder. The standard Starters are provided with ventilating covers in all cases, through which the movements of the switch can be observed.

Where a totally enclosed switch is required Messrs. Bray, Markham & Reiss, Ltd., have put on the market a standard pillar up to 60 H.P., containing double-pole switch and fuses if necessary, and starter. This pillar is watertight, and is operated from the outside of the case. We understand that they have a large number of these in hand to the orders of motor makers for His Majesty's Dockyards. For motors of 5 H.P. and under, where slow motion is unnecessary, they supply their E.E. type, which is a strongly constructed switch of the ordinary type, fitted with no-load and overload release. In all their starting switches special attention has been paid to providing against injury due to sparking, and for easy renewal of those parts where sparking must necessarily occur.



Messrs. Bray, Markham & Reiss's Motor Starter.

Catalogues and Lists.—R. W. Blackwell & Co., City Road, E.C.—Leaflet No. E12, relating to the "Shaw" non-arcing lightning arrester for lighting, traction and power circuits.

Portable Accumulators, Ltd., 210, Shaftesbury Avenue, W.C.—Price list of batteries for phonographs and musical instruments.

Sanders, Rehders & Co., 108, Fenchurch Street, E.C.—New pamphlet dealing with the Phœnix patent indicating and recording draught gauge for boiler and other furnaces.

Ferranti, Ltd., Hollinwood.—New lists:—No. 20, relating to single-phase power transformers, with schedule of standard sizes, efficiencies, &c.; No. 21, fully describing the Ferranti patent street transformer tanks.

American Manufacturers' (Central) Agency, 80A, Southwark Street, S.E.—Leaflet and sample of the Bashlin telephone disinfector—a little attachment for covering telephone mouthpieces with antiseptic diaphragms.

Estler Bros., 25, Laurence Pountney Lane, E.C.—A small blotting pad has been received, its object being to introduce to us the firm's castings, which are supplied in all descriptions, notably aluminium, gun-metal and brass, which they make at their new foundry, South Molton Road, Canning Town, E.

Paterson Engineering Co., Ltd., Amberley House, Norfolk Street, W.C.—Two well illustrated lists, "B" describing the Paterson water softener and filter, and "D" giving a detailed account of their condensation water purifier and grease eliminator for removing the last trace of oil from greasy condensation water.

Book Notices.—"Uber eine von den Strahlen des Radiotellurs in der atmosphärischen Luft erzeugte neue Strahlung." By B. Walter. Reprinted from *Annalen der Physik*. Leipzig: J. A. Barth.

"Der Wechselstrom und seine Anwendung in Röntgenbetriebe." By B. Walter. "Uber das Röntgensche Absorptionsgesetz und seine Erklärung." By B. Walter. Reprints from *Fortschritte auf dem Gebiete der Röntgenstrahlen*. Hamburg: Lucas Gräfe & Sillem.

"Trattato di Telefonia." By I. Brunelli and E. Longo. Rome: G. Scotti & Co. L. 1,25.

The Physical Review, Vol. XXI., No. 2, August, 1905, under co-operation of American Physical Society. Lancaster, Pa.; New York and London: Macmillan & Co.

Workmen's Compensation Case.—In the City of London Court last week, before his Honour Judge Lumley Smith, K.C., Ernest G. Fisher, electrician, Finsbury Park, made a claim of £300 against the Underground Electric Railways Co. of London, Ltd., for damages for personal injuries suffered while working for them. According to the *City Press*, plaintiff's case was that, while working for the defendants, he earned £3 a week. He worked at Holloway on the new tube now in course of construction between Finsbury Park and Brompton. After finishing his day's work, he was on his way back to the station, and was pushing his tools along on a trolley over the metals. He slipped and fell, putting his knee out of joint. He had done no work since the accident some months ago, and could not yet return. The defendants' case was that the plaintiff had no business to use the bogie in question, and that no case was made out under the Employers' Liability Act. The Judge agreed, and made an award under the Workmen's Compensation Act for the payment of £1 a week from a fortnight after the accident until further order. He also ordered the plaintiff to pay by instalments of 2s. a week the costs of the unsuccessful action under the Employers' Liability Act.

The Metric System.—The General Council of Chambers of Commerce of the Commonwealth of Australia, at a meeting of that body held in Sydney in June last, passed the following resolution:—"That this General Council of the Chambers of Commerce of the Commonwealth of Australia views with satisfaction the increasing public interest in the metric system of weights and measures, and expresses the hope that it may very shortly be adopted for England and the Empire generally, and recommends that such legislation may now be framed in the Commonwealth as will enable us at once to follow the home country in this change."

Liquidations.—The Electrical Investment Syndicate, Ltd.—On August 2nd the syndicate resolved to wind up, with Mr. W. H. Robson, 20, Great Winchester Street, E.C., as liquidator.

Light Cure and Electro-Therapeutic Institute, Ltd.—On August 4th, at Dover Street, Piccadilly, the company resolved upon voluntary liquidation, with Mr. W. F. Mohr, Broad Street Avenue, E.C., as liquidator, with an advisory committee.

Bankruptcy Proceedings.—Carrick & Topping.—The examination in bankruptcy of William Butchart Carrick and David Boyd Topping, sole partners of the firm of Carrick and Topping, electrical and mechanical engineers, 144, St. Vincent Street, Glasgow, and St. Andrew Street, Dumfries, took place last week in the Sheriff's Court, Glasgow. The state of affairs showed the liabilities to be £774 10s. 10d., and the assets £363 15s. 8d., a deficiency of £410 15s. 2d. The bankruptcy was attributed to work being accepted at too keen prices.

Anthony G. New.—A receiving order was made on July 26th on a creditor's petition against Anthony G. New, journalist and engineer, employed by the St. Martin's Publishing Co., Ltd., 44, St. Martin's Lane, London.

J. W. Martin & J. P. Poor, Junr. (trading as Martin & Co., electricians, Buckland and Portsmouth).—First meetings and public examination are to be held at Portsmouth on August 14th.

The "C. and C." Trolley Head.—Messrs. Cherry and Clive, the inventors of the "C. and C." trolley head with wire finding apparatus attached, wish it to be known that the whole and sole right of royalty in manufacture and supply is in the hands of Messrs. R. W. Blackwell & Co., Ltd., of City Road, E.C., to whom all communications relating to it should be addressed. Personal correspondence for the inventors should be sent to 2, Bedford Park, Plymouth, Devon.

LIGHTING AND POWER NOTES.

Brighton.—The Lighting Committee has recommended the T.C. to apply for a loan of £38,500, for the following purposes:—900 house-service connections, £9,000; feeders, £4,500; distributing cables, £15,500; 1,000 meters, £4,000; motors for hiring purposes, £4,000; additions to switchboards, accessories, &c., £1,500.

Bristol.—The accounts of the Corporation Electricity Department for the year ended March 25th last have now been issued, and we give herewith the principal items of interest, together with the figures of the previous year, for the purpose of comparison:—

	1904-5.		1903-4.
Total revenue (including £461 sundry profits)	£69,687	Including £376 sundry profits.	£61,372
Works and distribution costs	£23,035		£21,423
Total working costs	£31,936		£29,840
Interest charges	£17,168		£13,967
Sinking fund and stock redemption	£9,723		£9,357
Balance	+ £10,860		+ £8,207
Number of consumers connected	2,677		2,394
H.P. of motors installed	3,213		2,306
Equivalent number 8-c.p. lamps connected	274,176		234,098
Total units sold	5,215,528		4,299,504
Average price obtained per unit	2·962d.		3·18d.
Total working cost per unit	1·379d.		1·58d.
Maximum load	4,284 kw.		3,444 kw.
Capital expended to date	£590,984		£542,244

From the above credit balance of £10,860, together with £1,194 balance from last account, and £1,214 interest received on treasurer's banking account—a total of £13,269—£5,561 has been appropriated to reserve, £4,526 to depreciation, £2,231 to interest payments, and £952 has been carried forward to next account.

Burslem.—The T.C. on August 3rd decided to apply to the L.G.B. for a loan of £5,500 for works in connection with the proposed supply of energy to Tunstall.

Canada.—The Kakabeka Power Co., Ltd., has been incorporated with a capital of $2,000,000, to develop the water-power of the Kakabeka Falls, near Fort William, Ontario. The incorporators include Messrs. H. S. Holt, president of the Montreal Light, Heat and Power Co.. Charles R. Hosmer, a director of the Canadian Pacific Railway, and Frederick W. Thompson, general manager of the Ogilvie Flour Mills Co.

The Georgian Bay Power Co., of which Mr. B. F. Reesor, of Lindsay, is managing director, is about to commence construction work for the generation of electrical energy at Eugenia Falls. It is proposed to transmit power to Owen Sound and other points.

Meaford, Ont.—The T.C. has decided to engage in electric lighting on its own account, and also to substitute electric for steam pumping of water.

Montreal.—The fourth annual report of the Montreal Light, Heat and Power Co., recently submitted, showed that the gross revenue for the year amounted to $2,901,264.67, and the net profits, after providing for fixed charges, interest, &c., were $1,128,789.05, an increase over the previous year of $311,318.17 gross and $244,775.20 net. The report says: "There are under construction at the present time two new electric distributing stations of 10,000 H.P. capacity each, one to supply the east end and the other the north end of the city. Both of these stations will be fire-proof, and the electrical apparatus to be installed in them will be the best and most modern that can be secured."

The directors of the Montreal Light, Heat and Power Co. acquired by purchase the Provincial Light, Heat and Power Co., which controls for the Province of Quebec, the St. Lawrence Power Co., and owns the rights to all the surplus water of the Soulanges Canal, and it is intended to utilise the power from this source as soon as the conditions warrant it. During the year the company entered into a 25-year contract with the Montreal Street Railway Co., for an additional 7,000 H.P. of electric power, 4,000 H.P. of which is to be supplied by July 1st next, and the balance as the railway company may require it. The extent of the increase in this company's business may be realised when it is noted that during the year 463 electric meters were installed, and 936 consumers were connected representing 24,842 incandescent lamps, and 86 street arc lamps, and 53 motors, equivalent to 4,793 H.P., were added to the company's circuits. At the close of the year there were connected to the service over 55,000 gas and electric meters, and the prospects for additional business for the coming year are most favourable.

Cannock.—The L.G.B. has informed the U.D.C. that it is willing to consider an application from the Council for the working of the E.L. order by a company or syndicate. The Council has applied for a loan for carrying out the order with the assistance of a private company.

Caversham and Mapledurham.—The Reading Electric Supply Co. has informed the Reading T.C. that it intends applying to the B. of T. for a prov. order to supply energy to the above-named parishes. If necessary the Council will take steps to protect the interests of the Corporation. The company has informed the Caversham Council that if it intends to proceed with its prov. order, the company will drop the idea so far as Caversham is concerned.

Clacton-on-Sea.—At a meeting of the U.D.C. on August 3rd, a letter was read from the B. of T. stating that the question of revoking the E.L. order would be further deferred until the end of the year. The Council will discuss a scheme at the next meeting.

Colchester.—The T.C. has fixed the price of energy supplied to the tramways at 1½d. per unit.

Continental Notes.—Italy.—A company has just been formed at Buste Arsizio with a capital of £26,000, and the title La Societa Elettrica Alta Milanese, to acquire and carry on the electric lighting undertakings at Buste Arsizio, Gallarate and Legnano.

A concession has been granted to put down a plant to utilise the water power of the River Liro (Sondrio) in the generation of electrical energy for lighting and power purposes.

Germany.—An electric lighting and power installation is about to be established at the Minister Stein collieries of the Gelsenkirchen Bergbau Gesellschaft, at Gelsenkirchen.

Cotton Mills.—In regard to our note last week, the Lancashire Electric Power Co. inform us that not only is the sixth story of the Acme Spinning Mill to be operated by electricity, but the entire mill from top to bottom will be so operated. The mill has no fewer than 87,000 spindles, with all the machinery necessary in the work of preparation for the actual spinning.

Dumbarton.—Ground has been purchased in the district by the Electric Supply Corporation for the erection of a generating station. An early commencement is to be made.

Edinburgh.—The new Consumptive Hospital in connection with the Longmore Society, now nearly ready for opening, is having a complete installation of electric light and power fitted up, which includes a suction gas plant.

Gomersal.—Mr. Woodhouse, engineer to the Yorkshire Electric Power Co., has interviewed the U.D.C. with the object of obtaining its consent to an application by the company for a prov. order for supplying electricity within the area. He said he thought the company would be able to supply at 4d. per unit. The Council referred the matter to the General Purposes Committee.

Gordon Castle.—The whole of the work in connection with the lighting of the Castle by electricity has been designed, and is now being carried out, by Messrs. Drake & Gorham. The installation comprises some 532 lights of 8 and 16 C.P., and also a public supply throughout the village of Fochabers. The village lighting will be interesting, and Messrs. Drake & Gorham believe they will be able to establish a record with the prices charged to the crofters, who will be the chief users of the light. The contractors have recommended the Duke, as he merely wishes to cover expenses and interest, to charge 5s. per lamp per annum, without any limit as to the amount of energy consumed. The water power having been already laid on and the labour provided for the Castle lighting, there is really only the interest and depreciation on dynamo and mains and the cost of collection.

Greenock.—The accounts for the year ending June 30th show a surplus of £1,600.

Hastings.—The T.C. on August 3rd decided to abolish the system of charging for energy under the maximum demand system of 10s. for each 8-C.P. lamp demanded, plus 1½d. per unit for all energy consumed, and instead, to supply either at a flat rate of 6d. per unit; or under "the summer and winter system" (6d. and 2½d.); while consumers of over 12,000 units per annum are to be charged as under:—For the first 2,000 units per quarter, 4½d. per unit; next 2,000, 4d.; next 1,000, 3¾d.; next 1,000, 3½d.; next 1,000, 3¼d.; all over 7,000, 3d.

India.—An experimental installation of electric lighting and electric punkahs in railway carriages has been decided upon by the North-Western Railway.

Kingsbury.—The Works and Finance Committee has received notice on behalf of the Mutual Electricity Supply Co. that it is its intention to promote a prov. order for the supply of electricity within the district. The application is to be opposed by the Council. The Committee reports that an agreement between the Council and the North Metropolitan Electric Power Supply Co. has been exchanged. The agreement is for 42 years, and the Council receives £250 for its order. The Council is to receive one-third of the profits.

Leek.—A sum of £4,300 is to be borrowed for further extensions to the generating plant, mains, &c.

Llanelly.—The promoters of the South Wales Power Co. have paid the U.D.C. £500 in connection with the electric lighting agreement, on account of the £1,000 which they have undertaken to pay.

London.—Hampstead.—The agreement with the Aron Meter Co. for the maintenance of their type of meters, has been renewed for three years, and in view of the increased age of the meters, the price has been increased from 1s. 4½d. to 2s. per meter per annum.

Islington.—It has been resolved by the B.C. to serve a notice upon the contractors for the erection of the arc lamps in the Highbury district, requiring them to remove the lamps as the contract has not been carried out to the satisfaction of the Council. Mains extensions are to be made, at an estimated cost of £1,800, to the new post office in Upper Street, the estimated consumption at which will be 250,000 units per annum for lighting, and 85,000 units for power. In connection with the foregoing, a motion was adopted to the effect that where the consumption is 20,000 units and over per annum for lighting the charge be 3d. per unit. Motions were also passed (1) to ask the other Metropolitan B.C.'s to approach the L.C.C. requesting that body to include in the next General Powers Bill, clauses giving effect to the proposal to wire consumers' premises, and (2) to ask the L.C.C. to introduce a Bill on the lines of the recent Government Bill to supply electricity in bulk.

Gas Light and Coke Co.—The deputy governor of this company at the half-yearly meeting held on 4th inst., stated that "there never was a time when competition was so keen and prices for electrical energy so low." Comparing the corresponding two half years, there was a total reduction in income of £158,000, due to fall in price for residuals, reduction of 1d. in the price of gas, and a decrease in gas sales of 1·8 per cent. The experiment of the City Corporation in lighting certain streets was commented upon, and the deputy governor said that "the most important Corporation in the world realised that gas was a better and cheaper light for streets than electricity." The contract for the lighting of Victoria Station, secured by the company in competition with electric lighting, also afforded a subject for congratulation.

Stoke Newington.—The B.C. recently applied to the L.C.C. for sanction to a loan of £20,950, and for an advance of £3,000 in respect of it. The £20,950 is for the erection of a sub-station (£3,950), and for cables and machinery (£17,000). The L.C.C. has deducted £200 from the amount of £3,950, for sums not properly chargeable to a loan, and has only sanctioned, at present, the sum of £10,000 for the latter items. The B.C. is taking a supply from Hackney in bulk; it now proposes to extend its system, and to obtain energy from the North Metropolitan Electric Power Co.; but until the company's Bill to enable it to supply the B.C. has received the Royal Assent, the County Council will not issue its sanction to the whole of the £13,750.

Hackney.—The L.C.C. has agreed to the application of the B.C. to borrow £18,920 and for an advance on the same together with a sum of £3,288 already sanctioned, except that the former amount has been reduced to £18,420. The various sums which make up this total are £995 for land, £15,014 for machinery, mains, &c., £1,000 for meters, and £1,411 for street lighting.

Loughborough.—The T.C. has decided to hire out electric fans at 7s. 6d. per quarter, including the energy, and small radiators at 7s. 6d. per quarter, with energy at the ordinary power rates.

Macclesfield.—The T.C. has selected a site for the erection of electricity works, and has applied to the B. of T. for its consent to a D.C. supply on the three-wire system.

Malton.—From a newspaper report we gather that the town for more than a week has been in darkness after nightfall. The street gas supply has been cut off pending the installation of the E.L. by the local authority, and there has been some delay in completing arrangements.

Mexico.—It is reported that a Canadian company, the Mexican Light and Power Co., has purchased all the electric light and power works in the City of Mexico. The purchase price exceeds $10,000,000, and it is anticipated that extensions and developments of the system will cost about $25,000,000.

New York City.—Plans have been approved for the erection and equipment of a municipal lighting station at a cost of £1,500,000. This outlay is estimated to give the city 15,000 public arc lamps at an annual cost of £13 each and 300,000 incandescent lamps, mostly for the official buildings, at a cost of 2⅜d. a KW.-hour, as compared with £29 and 5d. paid at present to the New York Edison Co. and its allied corporations. The E.L. Commission estimates that operating expenses will amount to £253,400 a year, including all fixed charges, and interest on loans at 3½ per cent. Meanwhile the New York Edison Co. has placed an order for three new turbo-generators each of 16,000 H.P. capacity, and is planning ultimately to have ten of these large sets at its Waterside station on 39th Street, Manhattan. The new turbines are to be supplied by the Westinghouse Co., Pittsburg.

Redditch.—The Electricity Works manager recently reported on the progress made by the undertaking in the past fifteen months. On January 1st, 1904, the total number of consumers was 296, and on March 31st, this year, 383. On January 1st, 1904, the total lamp connection, in 8-C.P. lamps, was 15,844; on March 31st, 1905, it was 23,345. The gross profit on the fifteen months' working was £783, an increase of £323 over that obtained in 1903. The total cost per unit was reduced from 2·07d. to 1·67d.

Richmond-on-Thames.—The local E.L. and Power Co. has reduced the price of energy for lighting from 6d. to 5½d. per unit as from October next. The T.C. has passed a motion expressing disappointment at the trivial character of the abatement.

St. Annes-on-Sea.—The results of the past year's working of the U.D.C. electricity undertaking have proved very satisfactory. The gross profit amounted to £3,516, and, after meeting interest and sinking fund charges, there is a balance of £1,187; £1,000 has been carried to the credit of the rates, and the balance set aside for depreciation.

Salford.—The T.C. has decided that in future the charge for acting as a stand-by shall be £6 per KW. demanded, and ½d. per unit for energy.

South Africa.—PRETORIA.—On the recommendation of the Light and Power Committee, the T.C. recently approved of the following tariff for the supply of energy for power: For use at any time from 5.30 p.m. to 9.30 p.m. 5s. per month per H.P., and 2½d. per unit. Motors will be rated by the L. and P. department, with power to re-rate any motor without notice. Special rates will be assessed in cases where power is required during excluded hours. The desirability of substituting electric or motor traction for the horse traction on the present tramways, and extending the system when so improved, was also urged by the Committee.

VOLKSRUST.—Mr. Stephen, Government electrical expert, lately visited the town, and has made an inspection of the streets in which the Lighting Committee proposes to erect lamps. The total cost of the installation is estimated not to exceed £1,800.

JOHANNESBURG.—To enable the generating machinery to be erected upon its arrival, and on the recommendation of Messrs. Mordey & Dawbarn's resident engineer, the T.C. has agreed to allow the building contractors a bonus of £100 for every week by which the work is done in advance of contract time.

EAST LONDON.—At a meeting of the T.C. the following recommendation of the Lighting Committee was adopted:—That, having regard to the fact that the Harbour Board will be shortly generating electrical energy at the Board's own power station, the town electrical engineer be invited to report as to whether it would not be advisable to cancel the order placed with the London agents for additional machinery for the power station.

KLERKSDORP.—A scheme has been prepared by Mr. Dagnall dealing with the overhead system, which provides for 66 street lamps at a cost of £300, as compared with £500 for an underground scheme. This is being considered by the E.L. Committee.

Slate Mines.—The *Mining Journal* states that the report of H.M. Inspector of Mines for North Wales refers to the electrical developments in the slate mines of Merionethshire. At Llechwedd slate mine the Marvin-Sandycroft electric drill is giving great satisfaction. At Bwlch-y-slater mine a small electric plant has been erected for winding and lighting. At Maenofferen slate mine a plant has been installed for driving the mills and for haulage, pumping and lighting, and at the Croesor slate mine a plant of noteworthy character has been erected. The waterfall supplying the power for the latter mine is the largest that has yet been utilised in Great Britain, and the plant is the first application of the three-phase system to slate mining. The reservoir is 860 ft. above the power house, and the water is conveyed through 3,200 ft. of 12-in. steel pipe to two water turbines of 375 and 25 B.H.P. respectively. The larger turbine is direct coupled to a 250-KW. three-phase generator wound for 2,750 volts, and the smaller is direct coupled to two D.C. generators that can be used alternatively as exciters or for lighting. Power is transmitted to the mine by overhead lines. The H.T. current is transformed down to 220 volts, and applied for hauling from the lower galleries, for pumping 20,000 gallons of water an hour, for electric winches, for arc lighting, for an electric locomotive hauling a train of 30 tons at a speed of 4 or 8 miles an hour, and for driving 24 sawing tables and 24 dressing machines in the slate mill. The whole plant was designed and installed under the direction of Mr. Moses Kellow, F.G.S., the agent of the mine.

Southwick.—The U.D.C. has informed the County of Durham Electrical Power Distribution Co. that it is favourably considering the question of public lighting by electricity, and has asked the company to submit terms for the supply of energy.

Stafford.—In regard to the question of electricity *v.* gas, it is interesting to note that at a recent meeting of the T.C. an increase of 9½ per cent. in the output of gas and 63 per cent. in the output of electricity was reported.

Thornhill.—The U.D.C. has resolved to apply to the B. of T. for a prov. order for E.L. A similar order is being applied for by the Electrical Distribution Co.

Uffculme.—Messrs. Fox Bros., woollen manufacturers, of Wellington (Somerset), who are about to lay down an electrical plant at New Uffculme Mills, have offered to supply energy for public lighting at 3d.-2½d. per unit. The P.C. has decided to interview the firm on the matter.

TRAMWAY AND RAILWAY NOTES.

Bournemouth.—The T.C. has resolved not to run tramcars in the town on Sundays, although they run to Poole on five miles of the Council's system on that day.

At the meeting of the T.C. on August 1st the town clerk stated that the company's bill of costs in connection with the tramway purchase arbitration amounted to £5,416 3s. 8d., which had been reduced on taxation to £3,437 7s. 8d.

Canada.—The Canadian Pacific Railway Co. is considering the building of an electric railway between New Westminster, B.C., and Stevenson. It is also understood that the company is considering the installation of an electric plant at Owen Sound, Ontario, for lighting the buildings, and for the operation of the coal-hoisting plant.

WINNIPEG.—The Winnipeg Street Railway Co. is building a distributing station in Mill Street for the reception of the power to be developed at Lac du Bonnet by the General Power Co. The development at Lac du Bonnet will be about 30,000 H.P., and the initial installation will consist of four 1,200-KW. and two 2,000-KW. generators, which are being furnished by the Canadian General Electric Co. There is a 45-ft. head of water.

Cheriton (Kent).—Two schemes of electric tramways on the surface contact system have been placed before the U.D.C. by the National Electric Construction Co., Ltd., and the Traction Corporation, Ltd., respectively, both schemes being in connection with projected lines from Folkestone to Sandgate and Hythe *via* Cheriton.

Dewsbury.—A start has been made with the reconstruction of the steam tramways from Dewsbury to Gomersal, *via* Batley and Birstall; when they are finished it will be possible to travel by electric car from Dewsbury to Bradford, the two systems meeting at Birkenshaw. An effort is being made by the British Electric Traction Co. to induce the Bradford Corporation to reduce the fare between Birkenshaw and Bradford, so that the through return fare between Dewsbury and Bradford may be reduced to 1s.

Glasgow.—The report of the Corporation Tramways Committee for the year ending May 31st, states that the income amounted to £764,790 16s. 8d., and the working expenses to £387,167 9s. 2d., leaving a gross balance of £377,623 7s. 6d. The income of the previous year was £723,190 11s. 7d., and the working expenses £355,919 5s. 5d., leaving a gross balance of £367,271 6s. 2d. This year's gross balance thus shows an increase of £10,352 1s. 4d. The gross balance of £377,623 7s. 6d. has been applied in meeting the rental of the Govan and Ibrox tramways, payment to Paisley district tramways, interest on capital, sinking fund, income-tax, depreciation and permanent-way renewals, Parliamentary expenses and annual payment to the Common Good, these payments amounting in all to £287,437 19s. The net balance which remains amounts to £93,298 13s. 6d., of which £68,500 has been applied in meeting special depreciation on buildings, ducts, cables, overhead equipment and power station and sub-station plant, the balance of £24,798 13s. 6d. being added to general reserve fund. It is pointed out that although the gross revenue for the past year shows an increase of £41,600 5s. 1d. over the previous year, the average traffic revenue per car-mile has decreased from 10·58d. to 10·12d. This decrease is chiefly due to the augmented service of

cars which is now given on all routes. The net amount of borrowing powers as at May 31st, 1905, was £2,250,725 4s. 10d., of which there is unexhausted £467,641 11s. 3d. Additional borrowing powers to the extent of £400,000 had been asked under the recent tramways order. During the year £76,470 12s. 8d. was expended on capital account, bringing up the total to £2,763,381 12s. 3d. The balance of tramway debt owing to the common good now amounts to £1,783,083 13s. 7d. The balance at the credit of the depreciation and permanent way renewals fund was £777,636 18s. 8d., and of the general reserve fund £32,589 15s. 6d. During the year £24,318 19s. 2d. has been expended on the upkeep of the tramway track and in ordinary repairs. In addition, £72,176 10s. 10d. has been laid aside out of the year's revenue to meet the cost of the renewal of track. This sum is calculated at the rate of £500 per mile of single track. There has been deducted from the depreciation and permanent way renewals fund £13,300 9s. 2d., being the amount expended on renewal of track during year. The total cost of repairs to buildings during the year was £4,683 8s. 4d. This sum has been charged against revenue, and £10,349 5s. 9d. has been set aside to meet depreciation for the year. A further sum of £13,500 has been specially applied for depreciation of buildings out of the net surplus for the year. The total cost of the repairs to the power plant and sundry machinery during the year was £3,107 3s., and £19,370 19s. 8d. was charged against revenue to meet depreciation. A further sum of £15,000 has been specially applied for depreciation of power station and sub-station plant out of the year's net surplus. The total number of electric cars in stock is 683, of which 120 are top-covered. By the same time next year there will be 320 top-covered cars and 463 ordinary cars.

Ilford.—According to the annual statement of the Tramways Committee, the total receipts for the past year were £23,573, and after providing for all expenses, including repayment of loans and interest, there is a net surplus of £2,325. During the year over 5½ million passengers were carried, of whom 2¼ million purchased ½d. tickets.

Largs.—At a meeting of the T.C., a proposal was submitted for the construction of a tramway line between Largs and Wemyss Bay. The meeting was unanimously in favour of the scheme.

Liverpool-Southport Railway.—The B. of T. inquiry into the recent accident was held at Hall Road station on the 1st inst. by Col. Druitt. The proceedings were conducted in private.

London.—Hampstead.—A memorial from ratepayers in High Road, Kilburn, in favour of an electric tramway along the Edgware Road from Marble Arch to Cricklewood was received by the B.C. on August 3rd. The memorialists asked that a deputation might be appointed to confer with representatives of the Willesden U.D.C. on the subject, and this was agreed to.

L.C.C.—A short extension of the tramway system from Blackfriars, Waterloo and Westminster Bridges has been opened for traffic. The cars, instead of stopping in Tooting High Street, run on to Tooting Broadway. This line is shortly to be further extended to the county boundary at Merton, and to Tooting Junction railway station.

In their half-yearly report, the directors of the North Metropolitan Tramways Co. observe that for some time past negotiations have been pending with the London County Council for the surrender of the lease of its northern tramways, which would not have expired until June, 1910, and also for the purchase of the properties, cars, horses, &c. These negotiations have now resulted in an offer by the Council, which the directors recommend the shareholders to accept. The agreement, which is to take effect as from April 1st next, will, if ratified, put an end to various matters in dispute between the Council and the company, which might have seriously hampered the company in the efficient and profitable conduct of its business.

Metropolitan District Railway.—In the course of his speech to the shareholders of this railway, Mr. R. W. Perks, M.P., the chairman, made several interesting references to the electrification operations now proceeding; indeed, quite naturally electrification was the keynote of the whole speech. He said that the process of transition from steam to electricity would continue steadily for the next few months. The line was opened for electrical working on July 1st. Owing to a little mishap which took place in connection with the Circle trains, they had temporarily to suspend the Circle service; but they had been working well and satisfactorily—barring a few little incidental mishaps, which, of course, must happen in connection with such a change in the various services which they had put on since. They had now the whole of the Ealing service running, from Ealing at present to Whitechapel—10 electric trains. They had two trains from High Street to Putney running electrically, and running very well. On Tuesday last week they put on five trains to carry the Richmond service from Richmond to Whitechapel, and hoped this week to extend several of these services to East Ham; and four or five weeks hence they expected to be in a position to put on the Wimbledon and Whitechapel electric service, which would then only leave the Circle trains running by steam, and the North-Western trains, which they would haul forward from Earl's Court to Mansion House by their new electric locomotives, which were partially delivered. In addition to the 17 trains which they were now running electrically—the Ealing trains, the High Street to Putney trains, and the Richmond trains—they were running six electric trains on the Harrow-Ealing and Hounslow-Ealing services, making up 23 electric trains at the present moment, or 20 trains of seven cars—the Ealing-Hounslow and Ealing-Harrow trains being at present short trains. They were running over the busiest parts of the road—namely, from South Kensington to Aldgate—about 20 trains an hour; at one part of the day 22 trains an hour. In making provision for rolling stock, they had ordered 420 cars, which were in process of delivery. On July 31st they had received 268 out of the 420 cars ordered; and he was not quite sure whether the honour, or the reverse, of the late delivery should be claimed by the French company or by one of the British companies. They seemed to be running an almost even race in the late delivery of their cars. But the 420 cars which they had ordered, and which might be delivered in the course of a few weeks, would provide for a very largely increased electrical service. They were now carrying at the rate of about 70,000,000 of passengers a year of all classes, including season ticket holders, and they had a reasonable expectation of increasing that number to 100,000,000. The Metropolitan Co. were already carrying on their lines about that number, and he saw no reason whatever to doubt that this company would not merely equal, but largely exceed that number of passengers. Mr. Perks later said it was extraordinary how rapidly the share-holding proprietary in any of our railways completely changed. There was not more than about £300,000 ordinary stock in this company in the hands of proprietors who purchased that stock prior to the year 1885. The whole of the old proprietors who bought at large prices had sold out their holdings long ago—the bulk of them—and at the present moment the proprietary consisted, apart from the Underground Electrical Co., of people who had bought their stocks within the last twenty years and bought them, he imagined, at prices from 25 up to 36 or 37; so that when they were told that the Underground Co. would make too much profit by their stocks being taken at the discount at which they had issued them, they must remember that their large investment in ordinary stocks was alongside that of proprietors who, for the main part, had bought their own securities at very much the same price. The zone fares, which would involve a very great reduction in their charges, because they could carry people from Hammersmith to Aldgate and anywhere on that section for 2d., from Putney to Aldgate for 3d., and from Ealing to Aldgate for 3d., single journey, would not come into operation until they had completely removed the steam trains, substituting for them entirely electric trains, on the improved schedule of running. He then referred to their relations with the Metropolitan Co., particularly with reference to the Circle service. The accidents which arose on the opening day of their Circle service were due to the dislocation both of their positive and negative electric rails, and the Metropolitan Co. were now busily engaged in altering their electrical equipment so that they could run round this company's section of the Circle without in any way dislocating either the central or side rails. This company's cars were in a perfect condition at the present moment to run over the Metropolitan section of the Circle from South Kensington to Edgware Road, and away to Aldgate, but unfortunately, for reasons which, at the moment, he need not enter into, the equipment of their partner's cars had to be altered so as to enable their cars to run round this company's particular section of the Circle. They hoped that these alterations, which were now being made by the Metropolitan Co., would be completed in four or five weeks, and then there would be no difficulty in the two services interchanging on their respective lines, and they would run the services continuously round the Circle.

Newcastle-on-Tyne.—At the meeting of the City Council on the 2nd inst., the Mayor (Alderman Baxter Ellis) moved a report of the Tramways Committee relative to the revenue account for the year 1904-5. It is proposed that the sum of £9,000 be invested to form the nucleus of a depreciation fund. Having asked for permission to make a lengthy reference to the subject, he said the tramways were a trading concern with a capital of £1,130,757, and an income of nearly £200,000 per year. There were 50 miles of single track working. They had 185 cars in stock, and these had run during the year 4,326,152 miles. They had carried their total population 165 times over, and had made a gross profit for the year of £70,831. Their total working expenses had been 7·05d. per car-mile, against 7·19d. for the previous year, which was equal to a saving of £2,524 per year. Since they ascertained those figures, the weekly wage bill on revenue account alone had been reduced by £174 per week; the new manager had made further reductions which amounted to about £3,000 per year, and the manager told him that he would still have to make further reductions during the next few months. The net profit for the year had been £6,293, and to this was added the profit from the previous year, making in all £9,954, which they suggested should be placed to the credit of a depreciation fund They had paid for redemption up to March last, £83,371, and out of that amount had extinguished debt amounting to £81,318. He further mentioned that they had paid the Finance Committee £21,278 for interest and redemption incurred during construction, and they had paid the Newcastle Electric Supply Co. over £3,000 for the right to supply their own energy in Walker, whilst they had to pay them £1,500 a year for six or seven years to come. Sir William Stephenson said no man would persuade him that the plant had not depreciated 10 times the sum of £9,000 during the four years the cars had been running. The report was adopted.

At the same meeting the Mayor moved the adoption of the report of the Tramways Committee recommending the construction of tramways on Scotswood Road. The extension would commence at the termination of the present tramways, and would end at the northern approach to Scotswood Bridge, a distance of 1¼ miles. The estimated cost was £22,727, but they were already in possession of a good deal of the material. The report was carried by a large majority.

North-Eastern Railway.—In the half-yearly report to June 30th the following figures appear:—(Expenditure) Electric train working £15,824, increase £10,913. The steam train mileage run has been 12,707,500, decrease 369,157; electric train mileage 594,122, increase 540,720; total train mileage 13,301,622, increase 171,563.

Penge.—The tramways which will connect up Penge with the South Norwood terminus of the Croydon tramway system have been commenced. Messrs. William Griffiths, of Bishopsgate, are the contractors.

The question has been raised as to the obligation of the Croydon Council to connect up the line on its side of the border at South Norwood, a distance of about 500 yards, and a legal opinion has been given that that authority must connect up within six months of the completion of the Penge line, which will carry the tramway to close upon the London and Kent county borders.

Ramsgate.—A serious accident to an electric tramcar occurred at Ramsgate on the 3rd inst., by which six persons were injured. The car, about 11 a.m., was descending Madeira Road, a zig-zag thoroughfare leading from the East Cliff to the harbour, carrying the driver and conductor and five passengers. Owing to the heavy rain the road and rails were very slippery, and the car suddenly left the metals, running across the roadway and crashing into the fence erected to keep the pedestrians from the cliff edge. The car fell a distance of 30 or 40 ft., and landed on some condemned houses, in which it remained embedded. One of the five passengers leapt aside as the car struck the fencing, but the others were carried over. The driver and conductor also jumped from the car, but they were too late to save themselves from falling over the cliff. The car turned completely over, and its occupants had a wonderful escape from death, but all were injured. The driver was at first believed to be dead.

In response to the Mayor's appeal for a public inquiry into the frequent tramcar accidents there, and the recent one in particular, the town clerk has received a letter from the Board of Trade stating that an inquiry will be held.

St. Petersburg.—It is stated that invitations for tenders for the construction of the St. Petersburg electric tramway system have only been sent to German, French and Belgian firms, and not to British or American houses.

Seaham Harbour.—A public inquiry into the application of the Seaham, Murton and Seaton Tramways Syndicate for a provisional order to lay tramways in the district was held at Seaham Harbour on the 1st inst. by Col. G. F. O. Boughey and Mr. Henry Allan Steward, Light Railway Commissioners. The promoters are all considerable shareholders in the Sunderland and District Electric Tramways Co., which has a system laid that will be completed in two or three months. It is anticipated that in the future certain pits will be opened in the district proposed to be covered by the new system, and as the population requires the system, so it will be extended. The villages that will be served by the railway include Houghton-le-Spring, Hetton-le-Hole, with Easington Lane, Seaham, New Seaham, South Hetton and Haswell, Murton Colliery, Dalton-le-Dale, and two or three other places. Mr. David Balfour, civil engineer, said that they did not intend to erect generating stations, as the district was already covered by them. They would have a transforming station. They proposed to reduce the capital to £100,000, with borrowing powers as well. The Commissioners expressed the opinion that there was a considerable portion of the district which required means of access to Seaham Harbour.

Tunbridge Wells.—Four months ago the local omnibus company inaugurated a motor-car service at Tunbridge Wells. The cars, however, disappeared from the streets last week, and the horse-drawn omnibuses have been reinstated. The company state that they are negotiating for the acquisition of lighter cars.

United States.—A company with a capital of £300,000 is being organised in New York, for the purpose of introducing into America the three-phase alternating current electric traction system which the engineering firm of Ganz & Co. has developed in Europe.

Long Island Railroad.—Preparations were nearly completed on July 26th for the running of passenger trains on 16 miles of the Long Island Railroad between Brooklyn and Rockaway Beach. This is claimed to be the first instance of the actual conversion of a steam railroad to electric traction in the United States. Energy is supplied from a large power house at Long Island City, and is transformed at five sub-stations. At one station there is a 10,000-h.p. storage battery for use in emergencies or during the hours of peak load. The cars are very similar to those used in the New York subway, and are of steel, each motor-car having two motors. A train consisting of three motor-cars and two ordinary coaches has, during an experimental run on perfectly straight and level track, attained a speed of 57 miles an hour. It has been necessary to build platforms at the stations mainly in order to prevent passengers from coming into contact with the shoes which are attached to the outside of the bogie trucks. At the stations also the power rail is guarded by means of a double sheathing, so that it is practically impossible for anyone to come into contact with it, except by stooping down and inserting the hand through the opening.

Ohio.—The Lake Shore and Michigan Southern Railroad has arranged for the construction of a length of line with electrical equipment, in order to experiment with electric traction for goods traffic between Detroit and Toledo.

New York City.—Two new sections of the subway were opened for passenger traffic on July 10th, completing the work as far as Manhattan Island is concerned, and affording traffic facilities, by means of transfers, with the northern suburbs. Large ventilating fans have been put in at various points on account of a falling-off of traffic during the extremely hot weather, when it was found that the atmosphere in the tunnel was unendurable.

Brooklyn, N.Y.—The Brooklyn Heights Railroad Co., which operates several miles of electric street traction under arrangement with the Brooklyn Rapid Transit Co., has placed an order with the Westinghouse Co., Pittsburg, Pa., for two steam turbine electric generating units, each with a maximum capacity of 16,000 h.p., and 10,500 normal. These units will resemble those ordered recently for the New York Edison Co.

Chicago, Ill.—Judge Dunne, the Mayor of Chicago, who was specifically elected last April to initiate a scheme for the city to take over the local traction systems, has changed his views so considerably—doubtless as the result of Mr. Dalrymple's adverse report—that for the present it does not seem likely that any distinctively civic scheme will be proceeded with. Mayor Dunne now proposes to form a commission of five members, to be chosen by himself, to have charge of traction matters. This commission would construct new lines where needed, and regrant the old franchises as far as operating privileges are concerned to private companies on the basis that the dividends should not exceed 6 per cent., any excess over this amount going into the city treasury. Ultimately, according to Mr. Dunne, the city is to buy the existing lines, and he anticipates that the quickest way to attain this object is to let out the operating privileges for short terms.

West Bromwich.—At the meeting of the T.C. last week the Mayor said that statements had been made which were inaccurate and misleading. The Council was receiving 6½ per cent. from the tramway company on the outlay for tramways, and there were no arrears now owing. It was not correct that the reconstruction had cost £108,000; in fact, so far they had not spent £94,000, so that they were actually saving the company £6,000 out of the £100,000. His worship added that it was not true that the corporation was losing £2,000 a year by its agreement with the company.

West Ham.—The electric tramway system of the Borough Council was completed on Saturday last, when the new line between Stratford Broadway and Leytonstone was opened.

Wigan.—The Corporation has come to an agreement with the Hindley District Council with regard to the running of electric cars into the centre of Hindley, and the construction of the lines will soon be begun.

Yorkshire (Woollen District).—The Yorkshire (Woollen District) Electric Tramways, Ltd., have written the Dewsbury Corporation asking it to accept payment of one-fourth of the full assessment, pending the decision in a test case, and undertaking, in the event of the test case going against them, to pay the balance. The Corporation has decided to call upon the company to pay the full amount of the rate, and in the event of the test case being decided in favour of the company's contention—*i.e.*, that light railways are railways within the meaning of Sec. 211 of the Public Health Act—to refund any amount that has been overpaid.

TELEGRAPH AND TELEPHONE NOTES.

Philippine Islands.—Mr. John I. Sabin, president of the Pacific States Telephone and Telegraph Co., and Mr. Louis Glass, vice-president of the same company, have been jointly granted permission to construct an extensive system of telephone and telegraph lines throughout the Philippine Islands.

Newcastle.—Arrangements have been completed by the Postmaster-General and the National Telephone Co. whereby subscribers to the respective systems in the Newcastle district obtain direct communication with each other.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Trinidad-Demerara (No. 1)	Aug. 26, 1901	
Trinidad-Demerara (No. 2)	July 28, 1905	
St. Lucia-Martinique	May 7, 1902	
Dominica-Martinique	May 7, 1902	
Cayenne-Pinheiro	Aug. 13, 1902	
Reissa-Issa (Yemen) Camaran	Oct. 22, 1902	
Tarifa-Tangier	Jan. 18, 1904	
Closed { Vladivostock-Nagasaki	Feb. 9, 1904	
Closed { Port Arthur-Chifu	Mar. 9, 1904	
Jamaica-Colon	Jan. 5, 1905	
Bolama-Bissao	June 21, 1905	
Iquique-Antofagasta	July 21, 1905	
Cadiz-Tenerif	July 20, 1905	
Paramaribo-Cayenne	May 25, 1905	
Lagos-Kotonon	July 29, 1905	
Martinique-Paramaribo	Aug. 7, 1905	
Landlines.		
Puerto-Barrios	July 28, 1902	
Kertch-Soutehoum	Sept. 27, 1904	
Alaska landlines	July 10, 1905	
Communication with Brazil *via* Galveston	July 18, 1905	
Pekin-Kiachta	Aug. 5, 1905	Aug. 7

Telephones for Shavers.—A hairdresser at Paterson, N.J., U.S.A., has installed telephones in connection with the chairs at his establishment, so that his patrons can communicate with their offices whilst being shaved.

Wireless Telegraphy.—According to the *Daily Mirror*, the Midland Railway Co. is about to make experiments in wireless telegraphic communication with moving trains at Spondon, near Derby.

In the House of Commons last week, Sir S. King having asked whether, when the contract between the Marconi Wireless Telegraph Co. and the Admiralty was negotiated, the Admiralty were prohibited from extending the benefits of their contracts to the Army; whether similar privileges and rights were secured at the same time for the Army; and if so, to what extent they had been availed of, Mr. Arnold-Forster said:—I am informed that the Admiralty are pledged not to extend the benefits of their contract with the Marconi Co. to other departments. As regards the rest of the question, no rights or privileges have been secured for the Army from the Marconi Co.

The Yukon.—The U.S. Government is preparing to install a wireless telegraph system throughout the Lower Yukon country, mainly on account of the great difficulties of maintaining land wires in that district. During some experimental wireless work undertaken on behalf of the U.S. Government by Capt. Wildman, on the Tanana River, he was able to keep in constant communication with St. Michael's, which, in turn, connected him with Nome, Alaska and the outside world.

CONTRACTS OPEN AND CLOSED.

OPEN.

Acton.—August 21st. Arc lamp carbons and house fuse boxes for 12 months, for the U.D.C. See "Official Notices" August 4th.

Dublin.—August 15th. Alterations to coal storing and conveying plant at Pigeon House generating station. See "Official Notices" August 4th.

Dublin.—August 21st. A specially quick steaming water-tube boiler for the Pigeon House generating station. See "Official Notices" to-day.

Finchley.—August 15th. One 66-kw. motor-driven booster set, and two 1,200-ampere-hours storage batteries for the U.D.C. See "Official Notices" to-day.

Germany.—Tenders are about to be invited for the construction of an electric tramway in town of Unna, Westphalia.

London.—September 5th. Stoneware ducts for electric cables, including manholes, &c., for the L.C.C. See "Official Notices" to-day.

Mussoorie (India).—October 23rd. Supply and erection of steel power pipes, water motors, alternators with exciters, switchboards complete, transformers, induction motors, pumps, workshop machines; also bare copper overhead mains, insulators, and lightning arresters, arc and incandescent lamps, telephone equipment, workshop tools and general stores. See "Official Notices" July 14th.

Pontypridd.—September 2nd. Permanent way for the U.D.C. See "Official Notices" to-day.

Spain.—August 19th. The Director-General of the Telegraph Department, Carretas, 10, Madrid, invites tenders for the supply of 50 tons of galvanised iron wire, 4 millimetres in diameter and 5 tons of bronze wire 2 millimetres in diameter. The *Standard* says that the maximum price at which tenders will be received is 1,570 pesetas (about £47) per ton for galvanised iron wire, and 3,450 pesetas (about £108) per ton for bronze wire. A deposit of 5 per cent. of the value of the goods at the upset price is required to qualify any tender. "A foreigner, when entering into contracts for the performance of public works in Spain, must renounce by public act all rights to which he might be entitled by virtue of the law of his own country in so far as his contract is concerned, and accept any administrative decisions that may be issued respecting questions arising from that contract. In entering into such contracts a local agent is a practical necessity."

Spain.—September 20th. The Directorate-General of Public Works, Madrid, is inviting tenders for the concession of an electric tramway in Zaragoza. The *Standard* says that an application for this concession has already been made by the Zaragoza Tramways Co., who, at the same rates, will enjoy certain preferential rights over other tenderers. The competition will turn, in the first place, on the reduction of the tariffs proposed; and if two or more identical propositions are made, a further competition will take place verbally as to what reduction (if any) of the period (60 years) of the concession tenderers may be prepared to accept. Deposit 474 pesetas (£14).

War Office.—September 1st. Tenders invited for the purchase of surplus boilers, dynamos, &c., at Bermuda, Barbados, St. Helena and Woolwich. See "Official Notices" July 7th.

CLOSED.

Beckenham.—The U.D.C. has accepted the following tenders in connection with the Electricity Works:—

Messrs. Babcock & Wilcox, boilers	£1,171
General Electric Co., alternators (with Belliss engine)	1,604
Messrs. F. & G. Foster, extensions to E.L. works	1,798

Bath.—The following tenders were received by the Corporation electricity department for a storage battery:—

Tudor Accumulator Co.	£2,483 5
Chloride Electrical Storage Co.	2,190 17
Pritchetts & Gold, Ltd.	2,947 0
Premier Accumulator Co.	3,125 11
Accumulator Industries, Ltd.	2,378 0
Electrical Power Storage Co.	2,286 17
Do. do.	2,534 0
Do. do.	3,006 8
British Accumulator Co.	2,464 4
Hart Accumulator Co.	3,235 3
D.P. Battery Co., Ltd., (accepted)	2,490 13
Do. do.	2,790 0
A.B.P. Accumulator Co.	3,232 0

Brighton.—The T.C. on Friday accepted the tender of the Chloride Electrical Storage Co., Ltd., for a 260-cell storage battery having a capacity of 1,000 ampere-hours, for the Southwick power station, at £3,600.

Burslem.—The T.C. has accepted the tenders of Mr. J. H. Whittaker, of Dudley, for the wiring of the Widgwood Institute for electric lighting, at £62, and of the Town Hall, Surveyor's Office, fire station, and baths, at £214.

Colchester.—The T.C. has accepted the tender of Messrs. R. W. Blackwell & Co., Ltd., for extending the tramways from Military Road to Old Heath Road, at £3,937.

Darlington.—The T.C. has accepted the tender of Messrs. W. E. Dove & Co., Ltd., of Darlington, for the supply of electric motors for hiring out and hire-purchase.

Dartford.—The U.D.C. has accepted the following tenders for supplies to the Electricity Works:—

Reason Manufacturing Co., Ltd., slot meters.
Mr. E. E. Beaven, general stores.
W. T. Henley's Telegraph Works Co., Ltd., house service cut-outs.
Messrs. Johnson & Phillips, Ltd., cables and joint box.

Derby.—The T.C. has decided to order six cars from Messrs. Milnes, Voss & Co., of Birkenhead.

Hampstead.—The B.C. has accepted the tender of the Aron Meter Co. for the maintenance of Aron electric meters for three years, at 2s. per meter per annum.

Lewisham.—The B.C. has accepted the tender of Messrs. Dick, Kerr & Co., Ltd., for granite sett and wood paving for the tramway tracks, at £16,652 and £1,792 respectively.

Mirfield.—The U.D.C. on August 3rd accepted the tender of Mr. E. Brooke, of Huddersfield, for a switchboard for transforming station.

Newport (Mon.).—The following tenders have been accepted by the Corporation for extensions at the power station:—

Steam pipe-work, John Spencer & Co., Ltd.	£319
Cooling tower and condenser, Wheeler Condensing and Engineering Co.	1,454
Two Transformers, British Westinghouse Co. each	53

Salford.—The T.C. on August 2nd accepted the following tenders for supplies to the Electricity Works:—

United Asbestos Co.—Packings, twine, tape, &c.
Messrs. C. Macintosh & Co.—Rubber-insulated cables.
Messrs. Siemens Bros. & Co.—Black tarred and white tape.
Messrs. Rowland Carr & Co.—Trinidad bitumen and carbolite.
Messrs. Baxendale & Co.—Tubes and fittings and Brockie-Pell arc lamp globes.
Reason Manufacturing Co.—House meters.
Doulton & Co.—Earthenware pipes and conduits.
Veritys, Ltd.—Double-pole main switches.
General Electric Co.—Motors.
Messrs. Lancaster & Tonge.—Disconnecting boxes.
Simplified Underground Conductor Co.—Asphalte concrete.
British Thomson-Houston Co.—Patent automatic regulator.

Scunthorpe.—The Hart Accumulator Co., Ltd., have secured from the U.D.C. the order for storage battery of 122 of their standard lighting type cells.

Southport.—The T.C. has accepted the tender of the Burnand Transformer Co. for the supply of 30-kw. transformers, at £50 each.

THE ELECTRICAL ENGINEERS R.E. (VOLS.).

The following orders have just been issued:—

Monday, August 14th.—Manœuvres detachment parade headquarters at time notified.
Thursday, August 17th.—Recruits and non-efficients for Isle of Wight Camp, parade at Waterloo Station (L. and S.W.R.) at 12 noon.
Saturday, August 19th.—Efficients for Isle of Wight Camp, parade at Waterloo Station (L. and S.W.R.) at 12 noon.

J. J. F. O'Shaughnessy, Captain.
For O.C.E.E.R.E.(V.).

The Telephone Agreement.—The House of Commons on Wednesday considered this agreement, and after an excellent speech from the Postmaster-General, indicating the treatment that was to be meted out to the employés at the date of the transfer, and showing the undesirability of conceding the modification suggested by the Select Committee in regard to future municipal licences, the agreement was confirmed by 187 votes to 110.

NOTES.

The Administrative Power Bill.—Since our Parliamentary pages went to press the fate of this Bill has been settled for the present. According to Thursday's *Times*, the Bill may be regarded as dead for the Session, the motion for adjournment on Wednesday having deprived the promoters of the chance of proposing the suspension of the measure until next year.

Standard Leading Screws.—We have received a copy of the report of a Committee appointed by the Army Council in November, 1900, to consider the provision of standard leading screws for screw-cutting lathes. The details of the work done and the investigations carried out by the Committee are highly interesting. The necessity for a standard screw arose from the difficulty in obtaining interchangeability between the parts of guns and gun-mountings, although these were manufactured by first-class firms. As the result of the Committee's work, a standard screw, 4½ in. in diameter, and long enough to give a travel of 3 ft. with a nut 14 in. long, has been cut, and has been deposited at the National Physical Laboratory. The screw is mounted in a special leading screw-adjusting machine, which is at the service of manufacturers for correcting their leading screws. A maximum error of 0·0001 in. per 12 in. length of screw was contemplated in the preliminary arrangements, but it was found possible to greatly exceed this degree of accuracy. When mounted in the screw-adjusting lathe at Bushy, careful measurements showed that the movement of the tool carriage did not vary from the proper value by more than 0·0002 in. in the entire length of the screw, and after the insertion of a correcting cam not more than 0·0001 in. at any one point. The work of adjustment of the screw and the construction of the machine were carried out by Messrs. Armstrong, Whitworth & Co. Messrs. Vickers, Sons & Maxim, and Messrs. W. Muir & Co., were also represented on the Committee, as well as the Government Departments concerned.

It is interesting to note that the Committee considers that in individual end measure comparisons, 0·001 in. in 12 in., being the accuracy commonly obtainable in the general workshop, requires an accuracy of 0·0001 in. in 12 in. in the gauge room, and 0·00002 in. in the laboratory verification. The work done for the Committee shows that these limits of accuracy present no excessive difficulties when proper precautions are taken.

The details of the work and the construction of the machine are fully described and illustrated in the report, which may be had from Messrs. Wyman & Sons, Ltd., price 1s.

A Noisy Elevated Electric Railway.—The complaints made in regard to the noise produced by the running of the trains on the Berlin elevated electric railway have now been silenced by decisions of the Courts, which are to the effect that in view of the public-legal nature of the undertaking, the private rights of adjoining property owners recede to the background, as they are unable to exercise any influence upon an enterprise approved by the State. It appears that the owners of one particular site along the route of the railway sought to have the company compelled either to adopt noise-deadening contrivances or prohibited from making excessive noise. The company submitted that legal action against it was inadmissible, and this point has had to be settled first. The Reichs Gericht, in confirming the decision of the Kammer Gericht and the Land Gericht, holds that the railway is a means of communication which serves in a high degree the general public interests. Having regard to the common well being, the State is careful to protect opposing interests in the exercise of a right of State sovereignty. The Court refers to the regulations made under the Act in respect of the system of sanctioning plans. During the 14 days of the exhibition of the plans, it is open to any one to raise objections against the undertaking, and these must form the subject of negotiation. In this connection the authorities who decide the building plans have to impose upon the promoter the provision of such arrangements as are regarded necessary to secure the adjoining sites from danger; and it is only when these conditions have been fulfilled that the "police permission" to commence working can be granted. As a result of the decision of the Reichs Gericht, it is concluded that in view of its sovereignty, the State has taken in hand the protection of the public and individual neighbours against the dangers and disadvantages which may arise from working operations, that without the consent of the police authorities "undertakers" themselves cannot, even in the matter of details, depart from the plans as originally approved, and that third parties who believe themselves to be prejudicially affected in the use of their sites by working operations, are unable to force alterations upon the railway by legal action. They must apply, it is said, to the authorities who are entrusted with the preservation of the State police sovereignty, and eventually to the administration Courts—whatever this may mean.

A Cape Town Explosion.—The Commission of Inquiry into the recent explosion in Adderley Street, Cape Town, have completed their report. They find that the explosion was due to an accumulation of coal and water gas in an old sewer, and that the gas was probably ignited by the "Thermit" process of welding the tramway lines which was being carried on in the street at that time. They find that the electric cables were properly laid, with due regard to the safety of the public, and had nothing to do with the explosion. The municipality is severely criticised as to the way of laying down gas pipes, and the Government has been recommended to exercise control in such matters.

Electric Haulage on Canals.—The works in connection with the construction of the Teltow Canal, which will have a total length of 23 miles, with only one lock, are approaching completion, and it is expected that the undertaking will be brought into use before the end of the year. Already the power station which is to supply electrical energy for the working of the lock gates and incidental machinery and also for the operation of the electric locomotives running on rails along the sides of the canal for the towing of boats, is nearly finished and equipped with boilers and two 850-H.P. steam turbines and electrical generators, the the latter of which are now yielding current for the experimental working of the lock. The track for the locomotives on the entire eastern section has been laid on both sides, while the rails and standards for the overhead wires have been partly placed in position on the western section. It is anticipated that only 15 minutes will be occupied in the clearance of the single lock calculated from the time of arrival to that of departure, the average difference in the level between one section and the other being 10 ft. The haulage speed of the boats will be comparatively high in consequence of the almost entire absence of locks. The district at the western end of the canal is expected to be developed as a pleasure resort.

Labour Troubles in 1904.—In the annual report of the Labour Department of the Board of Trade on Strikes and Lock-outs in 1904, Mr. A. Wilson Fox, C.B., shows that the year was singularly free from industrial stoppages. The numbers of disputes, of workpeople affected and of working days lost were the smallest on record. The 354 disputes recorded in 1904 involved about 87,000 workpeople, or under 1 per cent. of the industrial population of the United Kingdom, exclusive of agricultural labourers and seamen.

Magnetic Observatories and Tramway Currents.—According to a correspondent of the *Financial News*, the Civil Tribunal of Nizza has just given judgement in a case of importance to the electrical industry. The well-known Paris banker, M. Bischoffsheim, founded at Nizza an observatory, which is managed by the Paris University, and has the special object of observing magnetic phenomena. From 1882 to 1890 the Institution recorded the most precise results; but from that date onward perturbations arose, rendering the records of the apparatus absolutely valueless. It was discovered that the cause of the trouble was the electric current used for the tramways, which left the rails and penetrated the ground as far as the magnetic observatory. M. Bischoffsheim, together with the Council of the Paris University, therefore sued the Nizza Tramway Co. for damages, as the Institution had obviously to be transferred to a more remote and safer site, if its researches and registrations were to be of any profit to science. The Judges declared the claims of the plaintiffs well founded, and ordered the tramway company to pay damages, which have been assessed at nearly £4,000.

Fatalities.—Henry Jenkins, a young electrician, lost his life in a lift accident at the new Ritz Hotel, Piccadilly, the other day. The lift was a temporary one, and intended solely for the carriage of materials during the construction of the buildings.

A ticket collector, aged 65, in the employ of the District Railway Co., was at work at Acton on July 27th, when the electric signalling apparatus failed and he walked along the line towards Mill Hill Park to pilot an engine. It was late at night, and after the train had gone by he was found lying in the 6-ft. way with an injury to his head. He was unable to explain what had happened, but said he had not been knocked down by a train. A large burn was noticed on the back of the leg about 9 in. from the heel, and it was stated by the railway witnesses that if Horsley stepped against the live electric rail, he would be burnt at that spot, and the shock would throw him across the 6-ft. way where he was found. Dr. Whiteman said he made a post-mortem examination, and found signs which were characteristic of injury by electricity. Death was due to shock caused by Horsley coming in contact with the live electric rail. The jury returned a verdict of "Accidental death."

Institution Notes.—The British Electro-Therapeutic Society held a three-days' meeting at Leicester last month. The following subjects were announced for consideration:—The present position of the treatment of carcinoma and sarcoma by electrical methods, neurasthenia, the X-rays in the diagnosis of pulmonary disease and stereoscopic radiography, while a report was to be given on the milliamperemeter as a measure of X-ray production.

Among the results of the recent Röntgen congress at Berlin has been the authoritative adoption by a special committee of the following terminology:—Röntgenology = the study of Röntgen rays, Röntgenoscopy = observation by Röntgen rays, Röntgenography = photography by the rays, Orthoröntgenography in place of orthodiagraphy, Röntgenotheraphy and the verb to röntgenise in their obvious meanings.—*Nature.*

Appointments Vacant.—Lecturer in telegraphy and telephony for West Ham Technical Institute; assistant lecturer in electrical engineering (£180) for Belfast Municipal Technical Institute; junior shift engineer for Dover (£80); switchboard attendant for Carlisle (25s.).

Gas.—An accumulation of coal gas in a main sewer at Leeds caused a very serious explosion last Saturday morning. The new electric tram lines were raised from their foundations; indeed, as one of the Press reports says, "the thoroughfare was literally blown into the air."

A Motor-Car Commission.—Parliament has appointed a Royal Commission on Motor-Cars, with Viscount Selby, late Speaker of the House of Commons, as Chairman. The other Commissioners are the Marquis of Winchester, Sir William Forwood, Mr. Henry (Chief Commissioner of Metropolitan Police), Mr. Mure (as representing Scotland), together with representatives of the Local Government Board and of Ireland.

Royal Assent.—The following Acts have received the Royal assent:—

Electric Lighting Orders Confirmation (No. 4) Act, 1905.
Electric Lighting Orders Confirmation (No. 5) Act, 1905.
Electric Lighting Orders Confirmation (No. 6) Act, 1905.
Electric Lighting Orders Confirmation (No. 8) Act, 1905.
Esk Valley Power-Gas Order Confirmation Act, 1905.
Glasgow Corporation (Tramways Consolidation) Order Confirmation Act, 1905.
Paisley District Tramways Order Confirmation Act, 1905.
Andover Lighting and Power Act, 1905.
Southend and Colchester Light Railways Act, 1905.
Whitechapel and Bow Railway Act, 1905.
Metropolitan Electric Supply Company (Acton District) Act, 1905.
South Lancashire Tramways Act, 1905.
Shropshire, Worcestershire and Staffordshire Electric Power Act, 1905.
Great Northern, Piccadilly and Brompton Railway (Various Powers) Act, 1905.
Metropolitan Electric Tramways Act, 1905.
Dublin United Tramways Act, 1905.
Charing Cross, Euston and Hampstead Railway Act, 1905.
Baker Street and Waterloo Railway Act, 1905.
Edgware and Hampstead Railway Act, 1905.
Gosport and Fareham Tramways Act, 1905.
County of London Electric Supply Company's Act, 1905.
North Metropolitan Electric Power Supply Act, 1905.
Shepton Mallet Gas Company (Electric Lighting) Act, 1905.
Central Electric Supply Company's Act, 1905.

Warm Work.—We are informed that at the fifth annual convention and exhibition of the National Electrical Contractors' Association, held at Boston, U.S.A., during the week ending July 22nd, there was a large attendance of prominent electrical contractors from all parts of the States. The excessive heat prevailing during the week caused the discarding of coats and collars at several of the business meetings, and even at the annual banquet.

OUR PERSONAL COLUMN.

[*The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* ELECTRICAL REVIEW *posted as to their movements.*]

Central Station Engineers.—The Tunbridge Wells T.C. has increased the salary of Mr. D. SMITH, assistant electrical engineer, by £25 per annum. We referred to this matter in our issue of July 14th.

At a special meeting of the East London (Cape Colony) Town Council on July 7th, Mr. J. MORDEY LAMBE, late borough electrical engineer of Kimberley, and at present with the Rand Central Electric Works, Ltd., was appointed, out of 74 applicants from England and South Africa, to the post of electrical engineer and tramways manager to the municipality.

The staff at the Blackburn Corporation electricity works have presented a timepiece to Mr. T. H. KEARSLEY on his marriage.

The Burslem T.C. has appointed Mr. H. W. EDWARDS, of Llangollen, as shift engineer at the electricity works at a salary of £104 per annum.

By nine votes to three Cheltenham T.C. has appointed Mr. WALTER J. BACHE, borough electrical engineer at Gloucester, as borough electrical engineer, at a salary of £400 a year.

Mr. GEORGE RIGBY, of Preston, has been appointed by Stockton-on-Tees T.C. as charge engineer at the electricity works.

The Devonport Electricity Committee have recommended the T.C. to grant the following increases of salary:—Mr. J. W. SPARK, electrical engineer, from £275 to £300 a year; Mr. W. J. STAMP, assistant engineer, from £140 to £150; Mr. J. H. MULLIS, junior engineer, from 30s. to 35s. per week; Mr. C. D. MILSOM, switchboard attendant, from 20s. to 25s. per week.

Mr. F. J. BAKEWELL has resigned the appointment of electrical engineer to the Kettering U.D.C. owing to their wishing to reduce the salary from £300 to £175 per annum. His assistant, Mr. W. A. WALKER has been appointed at the latter salary.

Tramway Officials.—The Bournemouth T.C. on August 1st appointed Mr. P. H. DI MARCO, late chief clerk and traffic assistant to the Poole Co., as clerk at the Lansdowne office.

The staff and employés of the Gravesend and Northfleet Electric Tramways, Ltd., have presented a marble clock to Inspector R. JOHNSON on his marriage.

General.—We are informed that Mr. H. B. BARLOW is no longer with Messrs. F. W. Heaton & Co.

Mr. E. KILBURN SCOTT, of Sydney University, lectured on "Electric Traction on Railways by Alternating Currents," before the Electrical Association of New South Wales, on June 23rd.

Messrs. Alfred Dickinson & Co., consulting engineers of Birmingham, notify that their London address is now 210, Gresham House, Old Broad Street, E.C., where Dr. JOHN MANNHEIM is in constant attendance. Mr. Alfred Dickinson is in town on Tuesdays and Wednesdays.

Mr. MARTIN KAUL, representing the European Electric Lamp Manufacturers' Syndicate, is staying for a short time at the Holborn Viaduct Hotel.

Mr. MURDOCH, assistant to Prof. Baily in the Heriot-Watt College, has been appointed head of the Electrical Engineering Department in the Municipal Technical School, Halifax.

NEW COMPANIES REGISTERED.

Newquay Electric Light and Power Co., Ltd. (85,451).—This company was registered on July 31st, with a capital of £15,000 in £1 shares, to carry on at Newquay and elsewhere in Cornwall the business of an electric light and power supply company in all its branches, and to adopt (1) an agreement with H. Foote, L. Milne and E. J. Owen for the acquisition of the undertaking and powers granted to them by the Newquay Electric Lighting Order, 1904, and the Electric Lighting Orders Confirmation (No. 3) Act, 1904, and (2) an agreement with Foote & Milne, Ltd., for the execution and equipment of certain works. The first subscribers are:—J. D. Dymond, 11, Beaumont Crescent, West Kensington, electrical engineer, 1 share; K. P. J. Jolivard, 36, Marney Road, Clapham Common, S.W., accountant, 1 share; Ellen I. Bullock, 48, Louisville Road, Upper Tooting, S.W., clerk, 1 share; E. E. Smith, 66, Victoria Street, S.W., Parliamentary agent, 1 share; E. J. Bussy, 28, Thornbury Road, Clapham, S.W., clerk, 1 share; J. Rogers, J.P., Truro, 200 shares; and E. S. Lowe, Quay House, Newquay, gentleman, 200 shares. Minimum cash subscription, 1,500 shares. The number of directors is not to be less than two nor more than seven; the first are J. Rogers and E. S. Lowe; qualification, £200; remuneration, £100 to £300 per annum (according to profits) divisible.

City of Ely Electric Light and Power Co., Ltd. (85,444).—This company was registered on July 31st, with a capital of £5,000 in £1 shares, to adopt an agreement with H. Foote, L. Milne, and E. J. Owen, providing for the transfer to the company of the undertaking and powers granted to them by the Ely Electric Lighting Order, 1904, and the Electric Lighting Orders Confirmation (No. 4) Act, 1904, and for the payment or part payment in shares for the erection and equipment of the company's works if the contract for such works be given to Foote & Milne, Ltd., and to carry on the business of suppliers of electricity for light, heat, motive power or otherwise, &c. The first subscribers (each with one share) are:—H. Foote, 46, Gillingham Street, S.W., electrical engineer; L. Milne, 69, Overstrand Mansions, S.W., electrical engineer; J. D. Dymond, 11, Beaumont Crescent, West Kensington, electrical engineer; K. P. J. Jolivard, 36, Marney Road, Clapham Common, accountant; Mrs. L. H. Foote, 46, Gillingham Street, S.W.; E. E. Smith, 66, Victoria Street, S.W., Parliamentary agent, and Ellen I. Bullock, 48, Louisville Road, Upper Tooting, S.W., clerk. No initial public issue. The number of directors is not to be less than two nor more than seven; the subscribers are to appoint the first: qualification, £200; remuneration, £100 per annum, divisible, with an increase according to profits.

Patent Electric Carbonising Co., Ltd.—This company was registered on August 2nd, with a capital of £2,000 in £1 shares, to acquire the patent No. 4,593 of 1905, granted to S. Roberts, of The Observatory, Liversedge, Yorks, or any other patents relating to electric or other processes of carbonising wool waste, noils, rags and fibrous substances, and to turn the same to account. The first subscribers (each with one share) are:—S. Roberts, The Observatory, Liversedge, traveller; H. A. Fleet, 7, Plevna Terrace, Savilltown, Dewsbury, woollen manufacturer; H. Kaye, Ravensthorpe, Yorks, woollen manufacturer; F. W. Watson, Ravensthorpe, Yorks, woollen blender; G. H. Briggs, Ossett, Yorks, manufacturer; S. Briggs, Ossett, mungo manufacturer; and Mrs. M. A. Mitchell, 3, Bank Street, Ossett. No initial public issue. Registered without articles of association.

CITY NOTES.

Consolidated Electrical Co.

THE third ordinary general meeting was held on Wednesday, August 2nd, at River Plate House, Mr. Herbert Allen presiding.

The CHAIRMAN, in proposing the adoption of the report (see next page), said he was happy to be able to address them in a less apologetic strain than on former occasions. There was only one really disconcerting feature in the report, and that was the loss of £3,595 on the manufacturing branch of the business. He did not think that loss would come as a great surprise to the shareholders, for in the last report they more or less prepared them for some loss, and, as a matter of fact, the amount was a mere bagatelle in comparison with what they had lost in previous years on their manufacturing business. It was unfortunately a fact that the company had been engaged in a trade in which it was impossible in these times, and in this country, to make any profit, unless one was operating on a very large scale. In the small way in which they had been conducting the business, he was quite satisfied that they could never make a profit out of the manufacture of telephone instruments. That was not a political meeting, but he could not help saying that the reason for the unsatisfactory state of the electrical engineering trade was what was misnamed free trade in this country. They were not the only concern engaged in that trade who were losing money. The position of the trade got worse year by year. Some of their rivals, and those who conducted their operations on a vastly larger scale than they did, made an astonishing display of figures, but to those who could read between the lines, those big companies showed the same tale of loss that they did, and he was convinced it was only a matter of time when those concerns would have to tell their shareholders the same unpalatable truths that he was telling them that day. Apart from the loss on the manufacturing part of their business, the profit and loss account would not look amiss, and he claimed that it fully redeemed the hopes he held out to the shareholders at the last meeting. He told them that they would effect many substantial improvements by various changes they were then making, and while their total net revenue for the past year showed an increase of £2,018, equal to about 100 per cent., their administration expenses had decreased by about the same proportion, having amounted to £1,553 as against £2,680. As they stated in the report, the adverse balance of £3,595 was arrived at without any deduction having been made

for depreciation. They had let their premises at Coventry, which was more than a set-off against any depreciation in their freehold or leasehold premises, and as to the plant and machinery, they had maintained that out of revenue. The previous year they wrote off enormous sums for depreciation, and therefore there was no necessity to do anything in that direction on the present occasion. The principal falling off in the telephone department had been in the Government departments. There had been no fault to find with the quality of the goods; it was simply a question of price. Fortunately, in place of the unremunerative telephone business, they had recently succeeded in attracting into their factory a considerable amount of work connected with tramways. They had almost completed an agreement for the disposal of their Canonbury works as a going concern, and if that were effected, there would be no further loss there. The company would still retain an interest in the concern as shareholders, and if the negotiations were successful, the business would be taken over as from March 31st last. The directors' efforts would then be directed to developing the investment assets, until such time as they could be realised with advantage. In the meantime the shareholders should be receiving moderate dividends. He believed there was a prospect of their paying a dividend next year. The mainstay of the company was its investments, and he had little hesitation in saying that they were worth £30,000 more than the figure at which they appeared in the books, and he believed they would show a further increase of from £12,000 to £20,000 within the next 12 months. It was mainly through the Anglo-Portuguese Telephone Co. that the position of the company had improved. Whereas the trading loss before the reconstruction was between £10,000 and £12,000, it was now under £4,000, and there was no debenture debt.

Mr. C. Woolley seconded the motion.

A long discussion ensued, in the course of which Mr. W. R. Lawson asked the chairman whether he would consent to the appointment of a committee to look into the accounts of the old company and to inquire into some of the points that had been raised at the meeting.

The Chairman said he should regard the appointment of a committee as a reflection on the board, and also as a reflection upon himself. However, he would say this—that if any shareholder liked to come to the office and ask for any documents, nothing would be refused.

Mr. Lawson said that would be perfectly satisfactory to himself, and he believed it would meet the wishes of the shareholders generally.

The report was then adopted.

The following is a copy of the directors' report:—

"The accounts for the year ended March 31st, 1905, show an adverse balance on trading account (exclusive of depreciation) of £3,595 16s. 8d., which is, however, reduced by sundry revenue credits to a net loss on the year of £717. But for the loss incurred in the manufacturing branch, there would have been no cause for disappointment with the result of the year's operations, as in every other direction the financial position of the company has been materially improved. The greater part of the trading loss was made in the earlier part of the year under review; in the last few months the factory has been decidedly busier on fairly remunerative work. Nevertheless, the directors, in pursuance of the policy foreshadowed at the last annual meeting, have under consideration the disposal of the Canonbury works, and negotiations with that object in view are in progress. Technical obstacles have prevented the payment of the dividend due on the preference shares, but it is hoped these may be shortly overcome. Furthermore, there is a reasonable prospect of dividends being resumed on the ordinary shares at the close of the current financial year. The diligent attention of the board has been given throughout the year to the company's investment assets, in which several beneficial changes have been effected. The Edison Gower-Bell Telephone Co., one of the company's subsidiaries, has been put into liquidation, and certain economies of administration have been effected thereby. By this step, also, the company acquires a large number of shares of the Anglo-Portuguese Telephone Co., instead of being, as formerly, only indirectly interested in that company. Although the investments have undergone considerable change, and have greatly appreciated in value during the past year, they are retained in the balance-sheet at the very low valuation put upon them a year ago. The directors hope to be able to announce at the forthcoming general meeting a further important addition to the investment assets of the company; as stated in the last report of the directors, it is to these that the proprietors must look for the recoupment of past losses and disappointments."

Dublin and Lucan Electric Railway Co.

The directors' report to June 30th, 1905, says that the receipts and disbursements respectively for the half-year are nearly identical with those of the corresponding period of last year. After providing for debenture interest there is an available balance of £1,249 6s. 5d., out of which the directors recommend the payment of the usual half-yearly dividend (£475) on the 5 per cent. preference shares, and of three months' arrear of dividend on those shares (£237 10s.). Also that £400 shall be paid to the contractors on account of the principal sum remaining due to them for electrical equipment, and that the balance of £136 16s. 5d. shall be carried forward to next half-year. The above-mentioned payments of £237 10s. and £400 will clear off all arrears of dividend on the preference shares to June 30th, 1905, and reduce the electrical equipment debt to £1,600.

The train mileage was 54,826, against 54,625 in the corresponding half of last year.

Great Northern and City Railway Co.

The Earl of Lauderdale presided at the half-yearly meeting held last Friday at Westminster Palace Hotel, and, in moving the adoption of the report, he said that no comparison of the corresponding period of 1904 was practicable because in that period the circumstances were exceptional and they were only open for 4½ months. The capital account for the half-year was only £575. The estimated expenditure for this half-year was £100,000, which was for the payment for the equipment of the line from Drayton Park to Finsbury Park, and for additional rolling stock as explained at the last meeting. The money had not yet been expended, so it appeared again as before. The receipts from all sources had increased by £9,731 during the half-year, as compared with the half-year ended December, 1904. The average earnings per week were £1,778, against £1,404, showing an average increase of £374 per week. The passengers carried were at the rate of 445,830 per week, against 201,062, an increase of 44,768. Those figures were exclusive of season tickets and were most encouraging. From the opening of the line they had had a continuous increase and they hoped that it would be maintained in the future. Building operations in the district between Wood Green and Tottenham were being extensively carried on and that ought to contribute additional traffic to the line seeing that it formed very convenient connections at Finsbury Park with the tramways serving that district. In regard to the actual working expenses, the rate payable to Messrs. Pearson's on that account was, and until the company took over the line would be, 50 per cent. of the gross receipts, and they did not at present see any reason why, when the company worked the line itself, that should be exceeded. Whether that would be so or not depended, of course, upon the increase or otherwise of the traffic. Messrs. Pearson reported that the ratio of working expenses to receipts had diminished each half-year since the opening of the line, and they were in a position to deal with a large increase in traffic without materially increasing the working expenses. There had been only one slight interruption of traffic during the half-year. The number of trains had been about the same as detailed at the last half-yearly meeting, and the number of passengers had increased from 5·65 to 7·68. Provision was being made for additional rolling stock to meet the expected increase in the winter traffic. Contracts had been given for the supply of additional cars, and these would be delivered from time to time commencing in October next. The directors were still of opinion that the extension to Lothbury should be undertaken as soon as the opportunity of raising the necessary capital admitted.

The report was adopted.

Anglo-American Telegraph Co.

The half-yearly meeting was held on Friday last at Winchester House, Mr. F. A. Bevan presiding.

The Chairman, in moving the adoption of the report, said that at the last meeting he ventured to take a somewhat sanguine view of the prospects of the company for the half-year which had now come to a conclusion, and though, perhaps, he might have been a little over sanguine, he thought that on the whole the prospects he held out had been fairly justified. They would have liked to have been able to pay the dividend to which they had been accustomed—15s. for the last quarter as well as for the first quarter of the year, but although they had not quite succeeded they were able to pay 14s., making 29s. for the half-year, as against 25s. for the corresponding period of 1904. That meant that they were paying the shareholders £14,000 more in dividends than they did last half-year, which he considered very satisfactory. The traffic receipts had increased by £15,711. The working expenses had increased by £2,130. Most of that was due to increases in salary, but, as they had carried 1,000,000 more words, they had naturally required more hands. The ordinary expenses of the ss. *Minia* had increased by £1,856 as she had been very busy in repairing the 1873 cable. The total increase of expenditure in the half-year had amounted to £5,346. The increased balance of £2,065 from December, 1904, gave them £12,717 for additional dividend. They had actually distributed an extra £14,000, and to do that they had taken £1,282 out of the amount that they brought forward from the previous half-year. The new half-year had commenced with an increasing traffic week by week during July, but he would like the shareholders to bear in mind that in the last half of 1904 there were very large increases during the last few weeks, which went up to £13,000 and £14,000 a week of gross traffic, and they could hardly expect to have those large increases again. Looking at the renewal fund for the year they had added from the revenue £20,000, and interest on investments had yielded £30,354, bringing the fund up to a total of £1,038,030. Unfortunately, however, they had had to deduct £13,681, being the balance of the cost of putting the *Minia* into perfect repair, and £35,182 had been expended in repairing two breakages which had occurred in their 1873 cable—£27,000 of which appeared in last year's accounts, and £8,000 in this. That cable had been in use for 32 years, and they must not be surprised at having had to spend such a large sum on repairing it, but it pointed to the importance of keeping the renewal fund at a large figure. After those deductions had been made, the fund stood at £985,725. He regretted to say that the Newfoundland legislature had taken it into their heads to impose a tax upon the company which amounted to £1,000 for their cables, and also other minor taxes upon messages, and it looked as if they would have to pay £4,000 or £5,000 per annum, if not more. The directors were very carefully considering the matter, and would do all in their power to try and get the legislation reversed, but they must not be too sanguine as to the results of any action they might

take. Besides that, they had invited another company to land a cable on their shores, so as to connect Newfoundland with America, so that they would now have—what they had never had before in that Colony—competition. With regard to the P. Q. case, the Court of Cassation had confirmed the judgement of the Appeal Court of Rouen in the company's favour, and no further appeals were now possible. They could only now accept whatever assets might be handed over to them, but he was afraid they would be very small.

Sir Gerald Fitzgerald seconded the motion, and the report was adopted.

Liverpool Overhead Railway Co.

The directors' report for the half-year ended June 30th says that the gross revenue receipts amount to £39,918, and the working expenses to £31,749.

The number of passengers carried during the last two years is as follows:—

	Half-year ending Dec. 31, 1903.	Half-year ending June 30, 1904.	Half-year ending Dec. 31, 1904.	Half-year ending June 30, 1905.
First class	766,160	735,223	705,215	673,637
Second class (including tramways)..	3,670,404	3,402,444	3,523,985	3,169,953
Workmen (special return tickets)..	1,459,939	1,486,754	1,384,552	1,714,523
Total	5,896,503	5,624,421	5,613,752	5,558,113

The directors regret that they are unable to report any improvement during the past half-year. The number of passengers carried was 66,308 less than during the corresponding period of 1904, but the reduction in the fares of the second class has more seriously affected the earnings, which show a reduction of £1,946. The balance on the working account for the half-year, after providing for interest on debentures and dividend on preference shares, amounts to £593, which the directors recommend should be added to the balance brought forward from last half-year.

Revenue Account.

Receipts from passenger traffic amount to	£39,191	8	9
Miscellaneous receipts and interest	726	19	3
	£39,918	8	0
Less working expenses	31,749	3	10
	£8,169	4	2
Deduct interest on mortgage debentures, and on calls paid in advance	4,029	1	9
	£4,140	2	5
Add balance brought forward, December 31st, 1904 ..	3,743	4	3
Leaving available for dividend	£7,883	6	8

Out of this balance the directors recommend the declaration of a dividend of 5 per cent. per annum on preference shares (less income-tax), leaving a balance of £4,336 11s. 6d. to be carried forward.

Central London Railway Co.

On Wednesday, August 2nd, Sir Henry Oakley presided at the half-yearly meeting held at Holborn Restaurant. In moving the adoption of the report, he said they had spent £11,000 on capital account, £8,000 of which had gone for improving their condensing apparatus at Shepherd's Bush, which, when the arrangements were finished, they hoped would lessen the consumption of coal. There was no alteration in the working stock. They had spent, this year, between £300 and £400 for improving and enlarging one or two of their sub-stations and in connection with ventilation. They had not done enough in the way of ventilation, but, by improving the arrangements, they were gradually extracting the air at each of their stations; by doing that they were, he thought, removing all cause for complaints as to the ventilation. Turning to the revenue account, they had carried, on the whole, a greater number of passengers by 68,000, but the peculiarity of it was that the ordinary passengers had increased by 90,000, but the workmen carried at half fares had fallen off by 30,000. The total number of workmen carried in 1904 was 3,081,000, in 1905 they numbered 3,051,000, a reduction of 30,000, but the number lost was comparatively small in proportion to the total. The expenses of working were the same except for the rates and taxes, which were a sort of bugbear which was ever pressing on them. They paid during the half-year £14,752, or £500 more than in the corresponding period, for rates and taxes. But for this there was only a difference of £30 or £40 in their working expenses, therefore, there was nothing to explain. The net result was that they had a balance of £90,201, as against £89,836 in the corresponding half-year of last year. After providing for the dividends and putting aside £10,000 for the deferred stock earned in the half-year they would carry over £34,000. They brought into the half-year £22,000, so they therefore earned 4 per cent. and had £12,000 additional undivided profit for the half-year. They found that they were better off than the other underground railways for they had an increase whereas the others had suffered a loss. They had now carried 214,277,000 passengers without an accident. He thought that did great credit to the manager and staff. The train earnings per mile was 5s. 6d. They began at 4s. 10d. and they had now reached 5s. 6d., practically the highest figures. The working expenses were stationary. That indicated that if they increased substantially the earnings per mile they would be able to continue their present cost of working. Another subject of interest to the shareholders was the proceedings in Parliament and the Royal Commission Report. They would remember that they deposited a Bill in Parliament for the continuation of their railway so as to make it a complete circle. It was suspended early in the Session, and only a day or two ago they had been informed that neither theirs nor any other competing Bill could go on this Session. They had, therefore, withdrawn it. The Report of the Royal Commission had recently been issued, but it was impossible to express any opinion regarding what the Commission recommended. The broad suggestions they made were that a skilled tribunal should be appointed to consider all schemes, and that they should either recommend to Parliament, or be authorised by Parliament to deal with, all applications for the construction of trams, railways, or tubes. The board, after close consideration, found it impossible to express any opinion as to the course they ought to pursue in the next Session until it was known whether a tribunal would be appointed. Therefore, he had only to report that day that the Bill they deposited this year was gone, and if they decided to bring it up again it would have to come before the shareholders at their next meeting. The only other matter was the Bill of the Great Western Railway Co., which they supported, for they looked upon it as the beginning of the opening of the Great Western suburban district.

Lord Rathmore seconded the motion, and the report was adopted.

Great Northern, Piccadilly and Brompton Railway Co.

The half-yearly meeting was held on Thursday of last week at Hamilton House, Victoria Embankment, Sir Henry Fowler, M.P., in the chair.

In proposing the adoption of the report, the Chairman said that the capital expenditure during the half-year had amounted to £681,750, and the estimated expenditure during the current half-year on capital account was £650,000. The engineers' reports on the progress of the works were most satisfactory. So far as the Holborn to Finsbury Park section was concerned, the whole of the tunnels for the two lines of way had been driven and lined with cast-iron from Finsbury Park to Holborn with the exception of two short lengths of small tunnel immediately north of Holborn station, which were well in hand and would shortly be completed. At Finsbury Park station the works were practically complete. 97 per cent. of the concrete for the permanent way road-bed had been laid in between Finsbury Park and Holborn. In the South Kensington to Holborn section, with the exception of the station tunnels at Holborn and about 320 lineal yards of running tunnel to the southward, the whole of the running and station tunnels on that section had been completed. The lift shafts at all the stations and the connecting passages had been nearly all completed, and the construction of the platforms had been practically completed at the following stations:—Brompton Road, Sloane Street, Hyde Park Corner and Down Street. At Dover Street and Piccadilly Circus stations the platforms were in progress of construction. Up to date 57 per cent. of the concrete for the permanent way road-bed had been completed. Practically the same rate of progress had been made on the Earl's Court section. The directors were quite satisfied with the way in which the work was being performed and the rapidity with which it was being carried out. The Underground Electric Railways Co. had paid their rent up to June 30th under the terms of the lease which admitted of the payment of a dividend at the rate of 4 per cent. per annum.

Lord Farrer seconded the motion, and the report was adopted.

Waterloo and City Railway Co.

The half-yearly meeting was held on Thursday of last week at Waterloo Station, Sir Charles Scotter presiding.

The Chairman, in proposing the adoption of the report, said that the accounts did not present any noteworthy features. The receipts were £200 more and the expenses £289 less than in the corresponding period a year ago. The dividend was the same—viz., 3 per cent., and the carry over was £658, which included £256 brought forward from the last account. As they needed only £675 to pay ¾ per cent. dividend, it would be seen that they very nearly earned that. Apparently there had been a falling off of 8,000 in the number of daily passengers, but that was more than made up for by the increase in the season tickets. If they made an estimate of the number of journeys made by season ticket holders and added them to the other passengers they got a total of 2,775,127, against 2,729,982 in June, 1904, or an increase of 45,145. The amount received in fares was £17,522, and the fare per passenger worked out to 1·51d., or a fraction over 1½d. This was slightly better than a year ago when it was 1·49d., or just under 1½d. The cost per train-mile worked out at 1s. 8¾d. as compared with 1s. 9½d. This decrease was chiefly accounted for by the fact that a year ago the working expenses included a sum of £300 for compensation to an unfortunate passenger who met with an accident when alighting from a train at Waterloo. The result was that the net receipts were more than sufficient to pay 3 per cent. on the Waterloo and City capital, and under the working agreement the South-Western Co. were entitled to retain one-third of the excess. A dividend at the rate of 3 per cent. per annum would absorb £8,100, leaving £658 to be carried forward. They did not anticipate any further expenditure on capital account. If more capital were wanted there still remained £105,000 available as borrowing powers. He need scarcely refer to the report of the London Traffic Commission; it was a very lengthy document, and they must wait and see whether any, and if so what, effect was given to the recommendations. It was no doubt desirable for Parliament to deal with new schemes on some definite plan, and there was also no doubt that these tube

lines, four of which had now been at work for some time, must afford great relief to the traffic in the streets.

The Hon. H. W. CAMPBELL seconded the motion, and the report was adopted.

Nernst Electric Light, Ltd.

IN the circular issued by the secretary for the extraordinary general meeting to be held on 14th inst. to confirm the agreement with the A.E.G., the secretary says:—

I am instructed by the directors to inform you that the board at the last meeting held proxies representing, approximately, £50,000 of the whole share capital of the company. There was, however, no necessity for a poll. Resolutions 1, 3 and 4, were carried by the requisite statutory majority, their being only three dissentients with regard to No. 1, and one with regard to 3 and 4, and it was mutually agreed between the shareholders and the directors that Resolution 2 should be modified by a reduction of the sum proposed to £2,000 and this was carried *nem. con.* A formal agreement embodying the offer negotiated in Berlin on July 11th has been prepared and completed with the Allgemeine Electricitäts-Gesellschaft dealing, in detail, with formal matters which were not considered by the directors to be sufficiently dealt with. This document has been now executed by both companies and any shareholder can inspect a copy during business hours at the office of this company.

Armorduct Manufacturing Co.—The capital of this company has just been increased by the creation of a further 1,000 ordinary shares of £5 each—*i.e.*, £5,000.

W. T. Henley's Telegraph Works Co.—The directors have declared an interim dividend on the ordinary shares at the rate of 10 per cent. per annum, less income-tax, for the half-year ending June 30th last, payable September 1st. The interim dividend for 1904 was at the same rate.

Stock Exchange Notices.—Applications have been made to the Stock Exchange Committee to appoint a special settling day in and to grant a quotation to—

Babcock & Wilcox, Ltd.—Further issue of 270,000 ordinary shares of £1 each, Nos. 530,001 to 800,000.

And to allow the following securities to be quoted in the Official List:—

Havana Electric Railway Co.—$6,957,000 Consolidated Mortgage 5 per cent. 50-year coupon bonds of 1952 for $1,000 each, Nos. 1 to 6,957. Shawinigan Water & Power Co.—$2,000,000 5 per cent. consolidated first mortgage bonds, Nos. 401 to 483, 1,851 to 2,000, 2,517 to 2,586, 2,621 to 2,802, 2,805 to 3,025, 3,036 to 3,041, and 3,044 to 4,000 of $1,000 each, and 4,305 to 4,860 and 4,895 to 5,000 of $500 each.

The Committee has appointed special settling days as under:—

Wednesday, August 16th.—American Telephone and Telegraph Co.—$3,980,000 4 per cent. collateral trust bonds of $1,000 each, allotted in London, Nos. 55,782 and 55,733, 56,551 to 56,906, 57,401 to 57,486, 58,633 to 58,657, 61,848 to 61,880, 61,929 to 61,931, 62,369 to 62,383, 66,002 to 66,267, 66,526 to 67,000, 67,251 to 67,745, and 67,751 to 69,980.

Wednesday, August 23rd.—Metropolitan Electric Tramways, Ltd.—182,181 ordinary shares of £1 each, fully paid, Nos. 1 to 40,785 and 249,942 to 391,337.

The Committee has also ordered the undermentioned to be quoted in the Official List:—

Edmundson's Electricity Corporation, Ltd.—Further issue of 10,000 ordinary shares of £5 each, fully paid, Nos. 70,001 to 80,000.

Chilian Electric Tramway and Lighting Co.—The meeting of this company was held on 2nd inst. in London. Sir Julius Wernher, in moving the adoption of the report and accounts, stated that the accounts submitted to them for the year 1904 showed a very satisfactory increase on the figures of 1903. They had carried 4,400,000 more passengers than in the previous year, and had a 50 per cent. higher profit in the lighting department, which seemed to be moving more in accordance with original estimates. They might look forward to large increases in that department, as the greater part of the town was without electric light. Since the closing of the accounts, the Deutsche Ueberseeische-Gesellschaft, of Berlin, had become interested in the company, by acquiring a controlling interest in its share capital.

Companies Struck off the Register.—The following companies have been struck off the Register, and are dissolved:—

Benfleet Electric Light and Engineering Co., Ltd.
Burn's Patent Tram Car Lifeguard Syndicate, Ltd.
Cable Members Club Co., Ltd.
Cardiff and Penarth District Light Railway Co., Ltd.
Electrical Thawing Syndicate, Ltd.
Electric Fur Machining Co., Ltd.
Metal Electro Amalgamating Syndicate, Ltd.
News and Entertainment Telephone Syndicate, Ltd.
O'Brien-Lennard Electrical Installation Co., Ltd.
Simplon Tunnel Syndicate Co., Ltd.
Steam Users Patents Co., Ltd.
Weymouth Electric Light and Power Co., Ltd.

South Wales Electrical Power Distribution Co.—An extraordinary general meeting of this company was held at Cardiff on Saturday, when it was resolved to create £100,000 additional debenture stock, bearing interest at the rate of 5 per cent. per annum, being the fourth and fifth instalments of £50,000 each, part of the £250,000 which the company is empowered to borrow under its Act.

Prospectus.—*Bombay Electric Supply and Tramways Co.*—The Electric and General Investment Co. is offering £600,000 4½ per cent. debenture stock in this company for sale at par, also 60,000 6 per cent. preference shares of £10 each. The list is to close on Monday.

STOCKS AND SHARES.

Wednesday evening.

PEACE has again assumed the position of paramount factor in the Stock Exchange markets, and while business is not brisk, quotations are well maintained on the hope of a satisfactory conclusion to the negotiations. Money continues plentiful, and the holiday month finds an unusual amount of capital ready for investments of a tempting nature. The fate of the Administrative County Bill will be settled, for the present session, while these notes are going through the press, but, so far, the probable massacre of the Bill has not affected prices. Nor is it likely to do so.

Fluctuations are few and far between. Supply shares have improved upon their firmer front in several cases. Metropolitan Ordinary are ¼ better at 10, twice their nominal value, and the buying of late has been very strong. It is prophesied that the company is now upon a dividend basis, of which 10 per cent. will prove the lowest distribution. County of London Ordinary moved up ⅛ to 8⅞, being now quoted 8⅝ to 9⅛, and the two Preference shares of the Charing Cross City undertaking recovered their slight decline of last week. Perhaps the City companies may benefit to a very small extent from the illuminations in honour of the French visitors. Edmundson's and Urbans show no variation. The new issue by the latter company was less successful than had been reasonably anticipated. Charing Cross Debenture came to market the other day, the price thereupon receding a point to 104. Brush Preference rose ¼ to 1½ upon a little buying, and South Metropolitan Ordinary and Preference are both $\frac{1}{16}$ firmer.

Newcastle-upon-Tyne Electric Ordinary are 8, and the Preference 6, for old and new shares alike in each instance. Hove Electrics are 8, Folkestones 5½, and business has been done in Oxfords at 6⅝. Bournemouth Ordinary are 12, the Preference 10¼, and Bromley Ordinary 5½.

Home Railway descriptions have generally improved upon publication of some fairly good dividends by the "Heavy" lines. But the electrical section is dormant. Great Northern and City Preferred are creeping up, and show a rise of 5s. at 5¼ upon the recent hopeful report. For a long lock-up investment the shares look attractive, and they might possibly rise an early sovereign upon any continuance of the demand. East London stock is 5. Districts eased off to 36¼, and Metropolitans to 91. Of the less familiar stocks, we may mention that Baker Street and Waterloo Debenture is 102, Charing Cross and Euston certificates 50, and Great Northern and Piccadilly script 50½. Central Londons display no change.

At the meeting of the London Road Car Co. on Tuesday, the chairman referred to the improvement in the receipts per car as the first-fruits of the motor-'bus. He spoke guardedly on the subject of the new traction, but the caution may have been due to a desire to prevent his words being put to unlicensed purposes by interested parties. The price of the £6 shares is now 6⅜. London United Preference have eased to 9⅜, but in spite of the dull Bank Holiday and the competition of the new river service for popular favour, the trams were mostly packed to overflowing on each day of the recess. Calcutta Trams remain good, a buyer having to give 9⅝ earlier in the week. British Electrics, on the other hand, are still dull. Several new power companies have been brought to within speaking distance of the final prospectus, but for such ventures a postponement of the issue until later on in the autumn will probably be considered prudent. South Wales Debenture stock is 109, and the shares 8⅛. Cleveland and Durham Debenture appears to be worth buying at par. North Metropolitan Trams eased to 4½ upon the County Council's offer of immediate purchase of the undertaking.

Prospects of a party fight in the House of Commons over the telephone agreement caused the trifling drop of ½ in National Preferred and Deferred, the other varieties holding their ground. The Debenture stocks show a tendency to harden. United River Plate Telephones are ¼ better at 7¼, and Chili Telephones have regained the 2s. 6d. they shed a week ago. These movements are greater than those in the telegraph market, where the changes seem trivial. Amazon shares rose ¼ to 2⅜, and Cuba Telegraphs are ½ firmer at 8⅜, the latter merely replacing an earlier loss. Anglo-American Preferred at 105½ is the fraction lower. At 12, Henley's are unaltered, the interim dividend being announced at the rate of 10 per cent. Callender's stay at 10½. Telegraph Constructions are 32. Manufacturing shares as a whole keep steady. Babcock & Wilcox at 3⅝ are ⅛ harder, and the Preference are $1\frac{9}{16}$. Willans & Robinson Ordinary, Preference and Debenture have 1½, 3 and 75½ for their respective quotations, and at 50s. Westinghouse Preference have moved down a fraction.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. †	Dividends for the last four years. 1902.	1903.	1904.	§ 1905.	Closing Quotations August 2nd.	Closing Quotations August 9th.	Business done week ended August 9th, 1905. Highest	Lowest.	Rise + or Fall −
34,800	African Direct Telegraph, 4 % Debs...	100	4 %	4 %	4 %	..	98 —101	98—101	..	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	..	2¼— 2¾	3 — 3½	2⅞	2 11/16	..
119,700£	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	Nil	Nil	..	70 — 75	70 — 75	73	..	..
763,580	Anglo-American Telegraph	Stock	60/6	61s.	2 3/16 %	29s.	58 — 60 xd	58 — 60	57½	..	..
3,118,210	Do. do. do. 6 % Pref.	Stock	6 %	6 %	5 1/16 %	58s.	105½—106½ xd	105 —106 xd	105⅝	102½	..
3,118,210	Do. do. do. Deferred	Stock	1/-	2s.	Nil	..	13½— 13¾	13½— 13¾	13 1/16	13 1/16	+ 3/16
44,000	Chili Telephone, Nos. 1 to 44,000	5	6 %	7 %	8 %	..	7 — 7½	7½— 7⅝xd	7 5/16	..	+ 1/16
1,932,856£	Commercial Cable Stlng. 500 year 4 % Deb. Sk. Red.	Stock	4 %	4 %	4 %	..	96½— 98½	96½— 98½	98½	97½	..
16,000	Cuba Telegraph	10	6 1/32 %	10 %	5 %	..	8 — 8½	8½— 9	9	8⅝	+ ½
6,000	Do. 10 % Pref.	10	10 %	5 %	10 %	..	17 — 18	17 — 18	17⅞	17½	..
12,931	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	..	3⅜— 3⅝	3⅜— 3⅝	..	..	..
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	..	9 — 9½	9 — 9½	..	..	..
30,000	Do. do. 4½ % Debs.	50	4½ %	4½ %	4½ %	..	100 —103	100 —103	100	99⅝	..
60,710£	Direct United States Cable	20	3½ %	3 %	3½ %	..	11¼ — 11⅝ xd	11¼ — 11½xd	..	..	..
74,500	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200, R.	100	4½ %	4½ %	4½ %	..	99 —101	99 —101	..	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	..	104½—106½ xd	142 —145	144¾	142½	−2
2,000,000	Do. 3½ % Pref. Stock	100	3½ %	3½ %	3½ %	..	89 — 91 xd	89 — 91	90¼	90⅛	..
1,836,814	Do. 4 % Mort. Deb. Stock Red. ..	Stock	4 %	4 %	4 %	..	107 —109	107 —109	108½	108½	..
300,000	Eastern Extension, Australiasia, and China Tele.	10	7 %	7 %	7 %	..	13⅜— 14½	13⅜— 14½	14⅛	12⅝	..
602,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	..	107 —109	104½—106½xd	..	..	−2½
300,000	East & S. Afric. Tel., 4 % Mt. Db., 1 to 3,000, red. 1909	100	4 %	4 %	4 %	..	99 —101 xd	101 —103	..	..	..
200,000£	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	..	101 —103	100½—102½	..	..	+ ½
180,887	Globe Telegraph and Trust	10	£3 16 7*	5½ %	5⅝ %	..	10⅝— 10⅞ xd	10⅝— 10¾xd	10 13/16	..	..
180,887	Do. do. 6 % Pref.	10	6 %	6 %	6 %	..	14⅜— 14⅝ xd	14½— 14⅝xd	14⅝	..	..
150,000	Great Northern Telegraph, of Copenhagen ..	10	12½ %	15 %	24 %	..	35 — 36	35 — 36	35¼	35⅛	..
46,500	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½ %	4½ %	4½ %	..	99 —101	99 —101	..	..	..
17,000	Indo-European Telegraph	25	10 %	10 %	13 %	..	51½ — 53½	51½ — 53½	52⅞	52⅛	..
72,680	Monte Video Telephone Co., Ltd. Ord.	1	3 %	3 %	..	..	¾— ⅞	¾— ⅞	..	..	..
1,983,333	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	108 —109 xd	107½—108¼xd	108¼	107½	..
1,966,667	Do. do. Def. Stock	100	4½ %	5 %	5 %	5 %	104 — 106 xd	103½ 105½xd	105½	103	..
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	6 %	12½— 13½ xd	12½— 13½xd	..	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	6 %	12 — 13	12 — 13	12⅝	..	..
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5⅜— 5⅝ xd	5⅜— 6	5 5/16	5 1/16	+ ⅛
2,000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½ %	3½ %	3½ %	..	99 —101	99 —101	100	..	..
1,689,593	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	..	102½—104½	103 —105	104½	103½	+ ½
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid	1	6 %	6½ %	6½ %	..	1 5/16— 1 7/16	1 5/16— 1 7/16	..	..	..
50,000	Do. do. do. 6 % Cum. Pref. ..	1	6 %	6 %	6 %	..	1⅜— 1½	1⅜— 1½	..	..	..
100,000	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	4 %	..	97 —100	97 —100	..	..	..
11,839£	Reuter's	8	5 %	5 %	5 %	..	7½ — 8	7½ — 8	..	..	..
3,237	Submarine Cables Trust	Cert.	6 %	6 %	6 %	..	126 —129	126—129	..	..	..
58,000	United River Plate Telephone	5	7 %	8 %	8 %	..	6⅜— 7⅛	7 — 7⅛	7 1/16	..	+ ⅛
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	..	5⅛— 5⅜	5⅛— 5⅜	..	..	..
179,947	Do. do. 5 % Debs.	Stock	5 %	5 %	5 %	..	107½—109½	107½—109½	..	..	..
15,609£	West African Telegraph, Shares	10	2 %	4 %	4½ %	..	8½— 9	8½— 9	..	..	..
30,008	W. Coast of America, 1 to 30,000 & 53,001 to 53,008	2½	Nil	Nil	Nil	..	1/16 — 1/8	1/16 — 1/8	..	..	..
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	..	99 —101	99 —101	..	..	..
207,930	Western Telegraph, Ltd., Nos. 1 to 207,930 ..	10	7 %	7 %	7 %	..	13⅜— 14½	13⅜— 14¼	14	13 1/16	..
75,000	Do. do. 5 % Debs. 2nd series, 1906	100	5 %	5 %	5 %	..	100 —102	100 —104	..	..	..
663,380	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	..	102 —104	102 —104	103¾	..	..
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	..	⅛— ¼	⅛— ¼	..	..	..
34,563	Do. do. 6 % Cum. 1st Pref.	10	7 %	7 %	6 %	..	8 — 8½	8 — 8½	8 1/16	..	..
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	..	5⅜— 6¼	5⅜— 6¼	..	..	..
80,000£	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	..	100 —103	100 —103	..	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

40,000	British Aluminium 7 % Cum. Pref.	5	Nil	Nil	Nil	..	4⅜— 5⅛	4⅜— 5⅛	..	..	..
20,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	Nil	Nil	..	4⅜— 5⅛	4⅜— 5⅛	..	..	..
20,000	Do. do. 4 % Funding Certs.	5	..	..	..	..	2⅝— 3⅛	2⅝— 3⅛	..	..	..
800,000£	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	..	99 —103	99 —103	..	..	..
133,301	British Electric Traction	10	8 %	6 %	6 %	..	8¼— 8⅝	8¼— 8⅝xd	8⅝	8 1/16	..
156,437	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	..	11 — 11¼	11 — 11½	11¼	11	..
1,000,000£	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	..	122 —124	122 —124	123⅜	..	..
250,000	Do. do. 4½ % 2nd Deb. Stock Red.	100	..	..	4½ %	..	97 — 99	97 — 99	98½	98	..
100,000	British Insulated and Helsby Cables	5	10 %	8 %	8 %	..	5¼— 6	5¼— 6	5 5/16	..	..
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	..	5¼— 6 xd	5¼— 6 xd	..	..	..
500,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	4½ %	4½ %	4½ %	..	101 —104	101 —104	..	..	..
50,000	¶Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	..	1/16— 1/8	1/16— 1/8	..	..	..
50,000	¶ Do. do. 6 % Cum. Pref. ..	£1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731 ..	2	Nil	Nil	Nil	..	⅛— ¼	⅛— ¼	..	..	..
150,000	Do. Non-cum. 6 % Pref.	2	6 %	6 %	6 %	..	1 — 1⅛	1⅛— 1⅜	..	..	+ ⅛
125,000£	Do. 4½ % Perp. Deb. Stock ..	Stock	4½ %	4½ %	4½ %	..	92 — 95	92 — 95	..	..	..
125,000£	Do. 4½ % Perp. 2nd Deb. Stock	Stock	4½ %	4½ %	4½ %	..	77 — 80	77 — 80	..	..	..
35,000	Callender's Cable Construction shares	5	15 %	12½ %	12½ %	..	10 — 11	10 — 11	..	..	..
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	..	5¼— 5⅜	5¼— 5⅜	..	..	..
300,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½ %	4½ %	4½ %	..	106 —108	106 —108	..	..	..
1,963,208	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	..	90 — 92	90 — 92	91½	..	..
523,396	Do. do. 4 % Pref. Stock ..	Stock	4 %	4 %	4 %	..	101 —103	101 —103	..	..	..
523,396	Do. do. Def. do.	Stock	4 %	4 %	4 %	..	78 — 81	78 — 81	79½	..	..
1,330,000	City and South London Railway	Stock	3½ %	2 3/16 %	2 1/16 %	2 %	38 — 40	38 — 40	39	38⅞	..
85,000	Crompton & Co., Nos. 1 to 85,000	3	5 %	2½ %	2½ %	..	1½ — 2 xd	1½ — 2 xd	1⅝	..	..
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	..	94 — 99	94 — 99	..	..	..
99,261	Edison & Swan Utd., "A" shrs., £3 pd., 1 to 99,261	5	Nil	Nil	..	..	1⅛— 1⅜	1⅛— 1⅜	..	..	..
17,139	Do. "A" shares, 01—017,139 ..	5	Nil	Nil	..	..	2 — 2½	2 — 2½	2 1/16	..	..
344,023£	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	..	83 — 88	83 — 88	..	..	..
100,000£	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	..	89 — 94	89 — 94	90	..	..
112,100	Electric Construction 1 to 112,100	2	6 %	4 %	Nil	..	⅜— ⅝	⅜— ⅝	..	..	..
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	2	7 %	7 %	7 %	..	1½— 2⅛ xd	1½— 2⅛xd	..	..	..
200,000	Do. do. 4 % Perp. 1st Mort. Deb. Sk.	Stock	4 %	4 %	4 %	..	93 — 96	93 — 96	..	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	5 %	..	9½ — 10	9½ — 10	..	..	..
200,000	Do. do. 4 % Mort. Deb. ..	Stock	4 %	4 %	4 %	..	97 —101	97 —101	..	..	..
200,000	Henley's (W. T.), Telegraph Works, Ord. ..	5	20 %	15 %	15 %	..	11½ — 12½	11½ — 12½	11⅝	..	..
200,000	Do. do. 4½ % Pref.	5	4½ %	4½ %	4½ %	..	5⅝— 5⅞	5⅝— 5⅞	..	..	..
45,900	Do. do. 4½ Mort. Deb. Stock	Stock	4½ %	4½ %	4½ %	..	109 —111	109 —111	..	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works..	10	10 %	10 %	..	..	15 — 16	15 — 16	15½	..	..
300,000£	Do. do. 4% 1st Mort. Deb. ..	100	4 %	4 %	4 %	..	100 —103	100 —103	..	..	..
37,500	†Liverpool Overhead Railway, Ord.	10	1½ %	1⅜ %	1½ %	..	3½— 3¾	3½— 3¾	..	..	..
10,000	† Do. do. Pref. £10 paid ..	10	5 %	5 %	5 %	5 %	9½ — 9¾	9½ — 9¾	..	..	..
37,350	Telegraph Construction and Maintenance ..	12	20 %	20 %	15 %	..	31 — 33	31 — 33	..	..	..
150,000£	Do. 4 % Deb. Bds., 1 to 1,500 Red. 1909	100	4 %	4 %	4 %	..	101 —103	101 —103	..	..	..
540,000£	Waterloo & City Railway, Ord. Stock	100	3⅜ %	3⅜ %	3⅜ %	3 %	90 — 92	9C — 92	91	..	..

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. § Interim dividends.
¶ From Manchester Share List.

Bank rate of discount 2½ per cent. (March 9th, 1905).

SHARE LIST OF ELECTRICAL COMPANIES *(continued)*.—ELECTRICITY SUPPLY COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years. 1902.	1903.	1904.	‡1905.	Closing Quotations Aug. 2nd.	Closing Quotations Aug. 9th.	Business done week ended Aug. 9th, 1905. Highest	Lowest.	Rise + or Fall —
29,377	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	† 5	8 %	10 %	10 %	..	10 — 10½	10 — 10½	..	..	..
10,623	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	..	9⅜ — 10¼	9⅜ — 10¼	..	..	..
288,782	Central Electric Supply 4 % Guar. Deb. Stock ..	100	4 %	4 %	4 %	..	103 —106	103 —106	..	..	..
80,000	Charing Cross and Strand Electricity Supply ..	5	10 %	8 %	8 %	..	6⅜ — 7⅛	6⅜ — 7⅛	6 11/16	..	..
80,000	Do. do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	..	5⅛ — 5⅜	5⅛ — 5⅜	..	..	..
40,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	..	4⅜ — 5	4 15/16 — 5 1/16	..	..	+ 1/16
40,000	Do. do. 1903	5	..	4½%	4½%	..	4⅜ — 5	4 15/16 — 5 1/16	4 15/16	4⅞	+ 1/16
350,000	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	..	104 —106	103 —105	..	..	— 1
44,436	*Chelsea Electricity Supply, Ord.	5	4½%	5½%	6 %	..	6 — 6⅛	6 — 6⅛	6⅛	..	..
150,000/	Do. do. 4½ % Deb. Stock Red. ..	Stock	4½%	4½%	4½%	..	108 —110	108 —110	108⅜	..	..
70,595	City of London Elec. Lighting, Ord. 40,001—110,595	10	5 %	5 %	6 %	..	10¾ — 11	10¾ — 11	10⅞	..	..
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	..	13 — 14	13 — 14	..	..	..
400,000/	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	..	122 —126	122 —126	..	..	..
300,000	Do. 4½ % 2nd Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	..	103 —105	103 —105	..	..	..
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4 %	4½%	4 %	8⅜ — 9	8⅜ — 9⅛	..	..	+ ⅛
30,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	..	11¾ — 12¾	11¾ — 12¾	..	..	..
400,000/	Do. do. 4½ % Deb. Stock ..	..	4½%	4½%	4½%	..	111 —114	111 —114	112¾	111½	..
250,000	Do. do. 4½ % 2nd Deb. Stock ..	Stock	4½%	4½%	4½%	..	103 —105	103 —105	104½	..	..
70,000	Edmundson's Electric Corporation, Ord. Shares ..	5	7 %	7 %	7 %	..	5⅞ — 6⅛	5⅞ — 6⅛	5 15/16	5⅝	..
80,000	Do. do. 6 % Cum. Pref... ..	..	6 %	6 %	6 %	..	6⅛ — 6⅜	6⅛ — 6⅜	6⅜	5¼	..
300,000/	Do. do. 4½ % 1st Mort Deb. Stk	100	4½%	4½%	4½%	..	105½—107½	106 —108	107	..	+ ½
21,000	Kensington and Knightsbridge Electric Ord. ..	5	10 %	12 %	12 %	..	11½ — 12½xd	11½ — 12½	..	..	..
136,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	..	97 —100 xd	97 —100	..	..	..
111,000	London Electric Supply Corporation, Limited, Ord.	3	Nil	Nil	3 %	..	1¾ — 2⅜xd	1¾ — 2⅜	..	..	..
60,000	Do. do. do. 6 % Pref...	5	6 %	6 %	6 %	..	5 — 5⅛	5 — 5⅛	5⅜	5¼	..
371,895	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	..	99 —102	99 —102	..	..	..
100,000	Metropolitan Electric Supply, 1 to 100,000	5	7½%	8½%	10 %	10%	9⅛ — 10	9⅜ — 10⅛	10⅛	9 5/16	+ ⅛
76,121	Do. 4½ % Cum. Pref. 1—71,106, £3 pd.	5	4½%	4½%	4½%	..	5⅜ — 5⅝	5⅜ — 5⅝	5 7/16	..	..
220,000/	Do. 4½ % 1st Mort. Deben. Stock ..	..	4½%	4½%	4½%	..	109 —113	109 —113	110¾	..	..
250,000/	Do. 3¾ % Mort. Deben. Stock Redem.	Stock	3½%	3½%	3½%	..	98 —100	98 —100	100¼	..	..
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	..	99 —101	99 —101	..	..	..
10,852	Notting Hill Electric Lighting	10	6 %	6 %	7 %	..	14 — 15	14 — 15	..	..	..
59,000	Do. do. 4 % 1st Mort. Deb... ..	100	4 %	4 %	4 %	..	100 —102	100 —102	..	..	..
40,000	St. James' and Pall Mall Electric Light, Ord. ..	5	14½%	14½%	14½%	10%	13 — 14 xd	13 — 14 xd	..	..	..
20,000	Do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	7 %	8 — 9 xd	8 — 9	..	..	..
150,000/	Do. 3¾ % Deb. Stock Red. ..	100	3¾%	3¾%	3¾%	..	97 — 99	97 — 99	..	..	..
12,000	Smithfield Markets Electric Supply, Ord.	5	2½%	4 %	4 %	..	2⅜ — 2⅝	2⅜ — 2⅝	..	..	..
50,000	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	..	76 — 80 xd	76 — 80 xd	..	..	..
65,000	South London Electricity Supply, Ord.	5	1¾%	3 %	4 %	..	3⅜ — 4	3⅜ — 4	..	..	..
100,000	South Met. Elec. Lt. & Power (Ord.	1	Nil	Nil	Nil	..	5/16 — 7/16	5/16 — 7/16	..	..	+ 1/16
50,000	*(Late Blackheath and Greenwich* 7 % Pref...	1	Nil	7 %	7 %	..	1½ — 1¾	1 15/16 — 1 17/16	..	..	+ 1/16
100,000	*Dist. E.L.Co.)* 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	..	106 —109	107 —107½	..	..	..
30,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	..	4⅜ — 4⅞	4⅜ — 4⅞	4⅞	4 3/32	..
30,000	Do. do. 5 % Cum. Pref. ..	5	5 %	5 %	5 %	..	5¼ — 5⅝	5¼ — 5⅝	5⅜	..	..
200,000	Do. do. 4½ % 1st Mort. Db. Stk. Red	100	..	..	4½%	..	104 —106	104 —106	106	105⅝	..
110,000	Westminster Electric Supply, Ord.	5	12 %	13½%	14 %	18%	12 — 12⅞ xd	12 — 12⅞ xd	12⅞	12¼	..
28,151	Do. do. 5 % Cum. Pref. ..	5	5 %	5 %	5 %	..	6⅛ — 6⅝	6⅛ — 6⅝	..	..	..

Shares not officially quoted:—Mackay Companies, ord., 41¾—42¼. Pref. 76—76½.

*Subject to Founders Shares † Unless otherwise stated all shares are fully paid. ‡ Interim dividends.

MARKET QUOTATIONS, Wednesday, August 9th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a ,, Nitric	per cwt.	22/-	..
a ,, Oxalic	per cwt.	32/-	..
a ,, Sulphuric	per cwt.	5/6	..
a Ammoniac, Sal	per cwt.	42/-	..
a Ammonia, Muriate (crystal) ..	per ton	£33 10	..
a ,, ,, ...	per ton	£30	..
a Bleaching powder	per ton	£5 5	..
a Bisulphide of Carbon	per ton	£15	..
a Borax	per ton	£13	..
a Benzole (90 %)	per gal.	7/-	..
a ,, (50/90 %)	per gal.	5/6	..
a Copper Sulphate	per ton	£20	..
a Lead, Nitrate	per ton	£25	..
a ,, White Sugar	per ton	£31	..
a ,, Peroxide	per ton	£27 10	..
a Methylated Spirit	per gal.	2/6	..
a Naphtha, Solvent (90 % at 160°C)	per gal.	5/6	..
a Potassium Bichromate, in casks	per lb.	3d.	..
a Potash, Caustic (75/80 %) ..	per ton	£22	..
a Potassium Cyanide	per lb.	7½d.	..
a Shellac	per cwt.	185/-	..
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6 10	..
a ,, Recovered	per ton	£5 10	..
a ,, Lump	per ton	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	..
a ,, Crystals	per ton	£3	..
a Sodium Bichromate, casks ..	per lb.	2½d.	..
a ,, Cyanide	per lb.	7d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots ..	per ton	£130	..
b ,, Wire, in ton lots ..	per ton	£168	..
b ,, Sheet, in ton lots ..	per ton	£166	..
b Babbitt's metal ingots	per ton	£43 to £140	..
c Brass (rolled metal 2" to 12") basis	per lb.	7¼d.	..
c ,, Tube (brazed)	per lb.	9½d.	¼d. dec.
c ,, ,, (solid drawn)	per lb.	8½d.	..
c ,, Wire, basis	per lb.	7¾d.	..
c Copper Tubes (brazed)	per lb.	10½d.	..
c ,, ,, (solid drawn) ..	per lb.	10½d.	..
g Copper Bars (best selected) ..	per ton	£83	£2 inc.

METALS, &c. *(continued)*.		Latest Price.	Fortnight's Dec. or Inc.
g Copper Sheet	per ton	£83	£2 inc.
g ,, Rod	per ton	£83	£2 inc.
e ,, (Electrolytic) Bars	per ton	£74	50/- inc.
e ,, ,, Sheets ..	per ton	£87	..
e ,, ,, Rod ..	per ton	£81	..
e ,, ,, H.C. Wire	per lb.	9¾d.	¼d. inc.
Ebonite Rod	per lb.	3/3	..
,, Sheet	per lb.	3/-	..
n German Silver Wire	per lb.	1/6	..
h Gutta-percha, fine	per lb.	6/- to 7/-	..
h India-rubber, Para fine	per lb.	5/6½ to 5/7	1½d. to 2d. in.
i Iron, Charcoal Sheets	per ton	£18	..
i ,, Pig (Cleveland warrants)	per ton	46/9	9d. inc.
i ,, Forgings, according to size	per ton	From £11	..
i ,, Scrap, heavy	per ton	47/6 to 50/-	..
i ,, Wire, galvanised No. 8 ..	per ton	£9 15	..
g Lead, English Ingot	per ton	£14 2 6 to £14 5	2/6 to 5/- dec.
g ,, ,, Sheet	per ton	£15 17 6	2/6 dec.
m Manganin Wire No. 28	per lb.	8/-	..
g Mercury	per bot.	£7 7 6	..
d Mica (in original cases) small ..	per lb.	6d. to 1/-	..
d ,, ,, ,, medium	per lb.	2/6 to 4/-	..
d ,, ,, ,, large ..	per lb.	4/6 to 8/6	..
p Phosphor Bronze, plain castings	per lb.	1/1 to 1/3	..
p ,, rolled bars & rods	per lb.	1/1 to 1/3	..
p ,, ,, strip & sheet	per lb.	1/3	..
o Platinum	per oz.	84/-	..
e Silicium Bronze Wire	per lb.	10½d. to 11½d.	..
i Steel, Magnet, acc'd'g to desc'p'n	per ton	£58	..
i ,, ,, in bars		£15 to £40	..
g Tin, Block	per ton	£139 to £140	£11 to £11 10 dec.
n ,, Wire, Nos. 1 to 16	per lb.	1/10	1d. inc.
p White Anti-friction Metals—			
"White Ant" brand	per ton	£43 to £65	..
j Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	8d.	..
j ,, 6 lea. Flax	per lb.	5⅜d.	..
j ,, 3 ply 10 lbs. Russian ..	per lb.	4½d.	..
j ,, 10 lbs. Russian, single ..	per lb.	4¾d.	..
j ,, 180 lbs. Jute rove ..	per ton	£11	..
k Zinc, Sh't (Vieille Montagne bnd.)	per ton	£27 15	..

Quotations supplied by Messrs.:—*a* G. Boor & Co.; *b* The British Aluminium Co., Ltd.; *c* Thos. Bolton & Sons, Ltd.; *d* F. Wiggins & Sons; *e* Frederick Smith & Co.; *f* India-Rubber, G.P. and Teleg. Works Co., Ltd.; *g* James & Shakspeare; *h* Edward Till & Co.; *i* Bolling & Lowe; *j* Walter H. Hindley and Co., Ltd.; *k* Morris Ashby, Ltd.; *m* W. T. Glover & Co., Ltd.; *n* P. Ormiston & Sons; *o* Johnson, Matthey & Co., Ltd.; *p* The Phosphor Bronze Co., Ltd.

Electric Omnibuses in Berlin.—The proposals for the introduction of electric omnibuses, which have been abandoned both in London and Berlin, are reported to have been revived in the German capital. It would, however, appear that although motor-omnibuses in general are in contemplation, the question of adopting those worked by electric motors and batteries is not the primary consideration in Berlin. What has taken place there, at all events in regard to electrical vehicles, is that the Allgemeine Electricity Co. has built an electric omnibus for its subsidiary company—the New Automobile Co.—which has been tested in the streets of Berlin. The 'bus is of the double-deck type, and has been tested as to its capacity for overcoming rising gradients. It is not intended for use in Berlin, but rather as a specimen vehicle for the purpose of demonstration in foreign cities. It is not quite certain from local reports whether the omnibus embodies any new features in regard to the weight and output of the batteries, or whether it is merely a speculation on the part of the New Automobile Co. Motor-omnibuses of the petrol type are, however, to be promoted by other firms after the London style. Yet many of the London 'buses are declared to have been obtained from Germany—at least the chassis, which are the principal parts of the vehicles.

THE FARADAY SOCIETY.

The "Centrifugal" Copper Process.

The Faraday Society wound up a successful session on July 3rd, when a programme containing no fewer than seven items was bravely grappled with. Of these, however, two papers were taken as read. Mr. Sherard Cowper-Coles opened with a description of the latest developments of his well-known "centrifugal" process for the electro-deposition of copper tubes and sheets. Rotating cathodes have, of course, been used since the days of Wilde, who, in 1875, patented a process for the deposition of copper on iron rolls for printing purposes; and the Elmore process, which successfully attains the required character of deposit by a combination of burnishing the cathode deposit and circulating the electrolyte, has been in commercial operation for some years past in England, Germany, France and Russia, and is now responsible, according to the figures submitted to the meeting by Mr. A. Stanley Elmore, for an aggregate output of nearly 7,000 tons per annum, equivalent to 2½ million sq. ft. of deposited tube. Mr. Cowper-Coles, however, appears to make use, in ordinary everyday working, of much higher current-densities than have been regularly employed in other practical processes, and the special novelty of his "centrifugal" process seems to lie in the fact that he employs without difficulty very high current densities, from 100 to 200 amperes per sq. ft. at a voltage of 0·35 to 0·8 respectively, by the simple expedient of rotating the cathode at so great a speed that the rapid renewal of the impoverished electrolyte at the point where that renewal is chiefly valuable, namely, at the cathode, combined with the surface friction of the electrolyte rubbing against the freshly-deposited metal, which, as Mr. Cloud pointed out, has the effect of drawing out the particles of metal into long fibres, and so preventing crystalline formation, allow a good tough and smooth metal to be deposited in spite of the high rate of precipitation, and without the necessity for using mechanical burnishers, such as are employed in the Elmore process. For every current density there is, in fact, a critical peripheral speed, above which smooth reguline copper is deposited, and below which the metal is nodular, brittle and even incoherent. Mr. Cowper-Coles's method of determining this critical speed under any particular conditions is to employ a revolving cathode in the form of a cone, noting at what zone on the cone the deposit passes from the nodular to the smooth state of surface. Mr. Cowper-Coles ascribes the smoothness of his deposits to the fact that the rotation of the cathode drives away any particles of dirt or suspended matter that would otherwise tend to settle on the cathode, and form the roots of "trees" or nodular growths. This, no doubt, is partly true, and it explains why, by the "centrifugal" method, anodes more impure than are usually employed can be satisfactorily used as the raw material; but there is still much obscurity surrounding our knowledge of the true cause of these "trees" and "nodules" in electro-deposition generally, and the fact that the addition of glue, for example, to a copper bath will prevent the growth of such excrescences, shows that Mr. Cowper-Coles's explanation is, at the best, only a part of the whole truth. A thorough investigation into the causes of these strange phenomena would amply repay the time and trouble spent upon it; it may be commended to the consideration of those in charge of some of the few electro-chemical laboratories in this country Mr. Cowper-Coles has lately devised a new method of driving the cathodes. Formerly the mandrels were suspended from above on ball-bearings, and attached to the spindles were Pelton wheels, which were driven by the electrolyte impinging against them. In the latest form of plant, however, annular vats have been employed, and the mandrel, still suspended from above, is driven by worm gearing from below, as shown in fig. 1. By this method of driving there are no working parts—nothing but the cathode surface itself—in the electrolyte, and there are no glands or stuffing boxes to get out of order or cause trouble. An 8-ft. mandrel has only to be driven at about 50 r.p.m. to exceed the required critical peripheral speed, which is about 1,000 ft. per min., so that the mechanical difficulties are of the slightest.

An ingenious device has recently made it possible to utilise the "centrifugal" method for the manufacture of copper wire direct from crude anodes in practically one operation. Mr. Cowper-Coles has found that if an angular or V-shaped dent, with a perfectly sharp corner, be scratched on the surface of his mandrel cathode, and then copper deposited in the usual way, the V-scratch causes cleavage-planes to be formed in the deposited metal, much as if the metal were cast in an angular mould, so that it becomes possible quite easily to strip away the deposit in the form of wire of the section shown in fig. 2. The wire as deposited can be immediately drawn down into ordinary wire of circular section. In the wire deposit shown at the meeting the scratches were $\frac{1}{16}$ in. apart; hence on a standard 7-ft. mandrel, 6 ft. in height, nearly 5 miles of deposit—that will draw down, of course, into a much greater length of finished wire, depending on the section—can be produced in one operation. If this clever invention is commercially successful a saving of from £10 to £15 per ton of wire, which is the cost of making wire from raw electrolytic cathodes, should be effected. By a modification of the method Mr. Cowper-Coles has produced copper tape, such as is used for trunk telephone lines, much thinner than is at present produced from "cathodes" at a cost of some £20 a ton. The expense of fine copper "non-inductive" tape now limits its use to trunk lines only; electro-

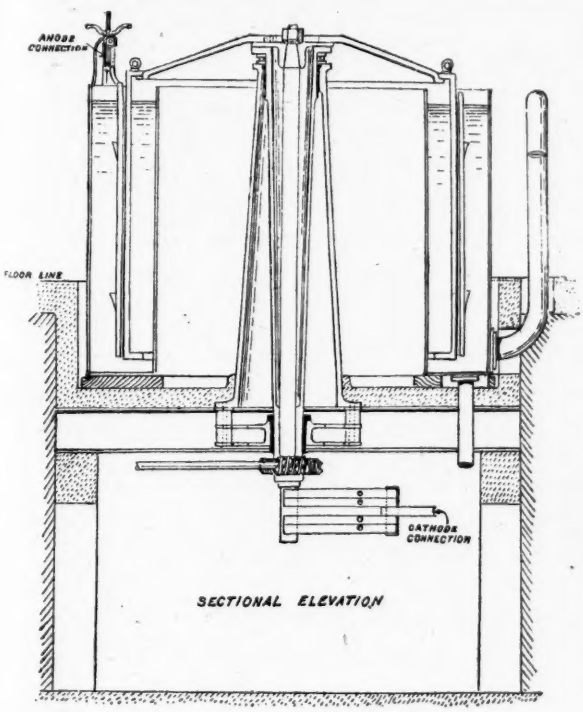


Fig. 1.

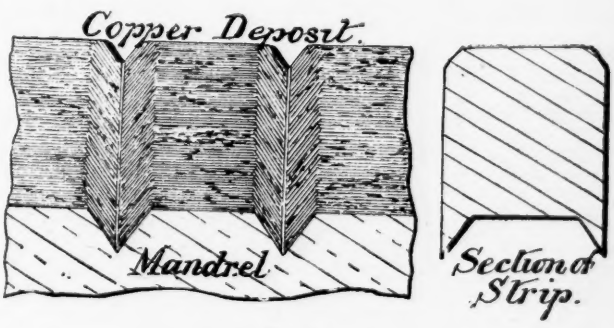


Fig. 2.

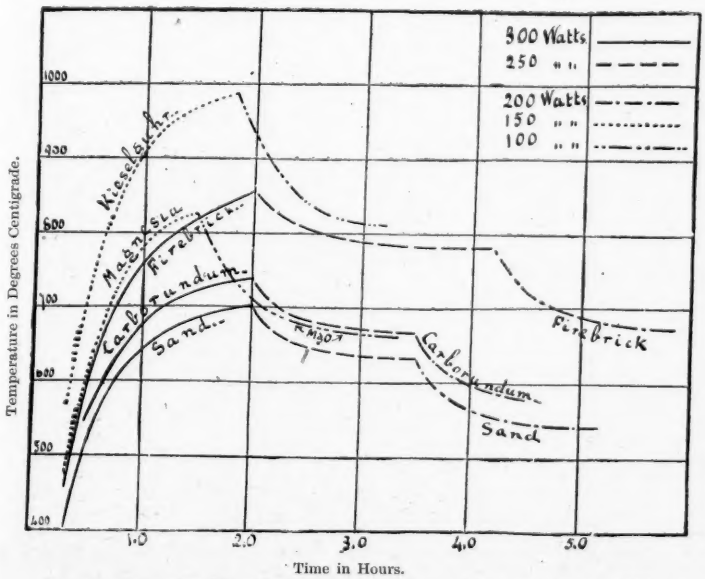


Fig. 3.—Relative Heat-Insulating Power of Materials (see p. 236).

lytic tape, however, ought to be within the reach of all telephone lines.

The second item on the programme was a paper by Prof. W. W. Haldane Gee on "Balanced Electrodes," read in abstract by Mr. R. S. Hutton.

Balanced Electrodes.

A balanced electrode, as its name, perhaps, does not altogether imply, is simply a weight voltameter, in which the cathode plate does not have to be removed from the bath and dried in order to be weighed, but, being attached to an ordinary chemical balance, can be weighed in place at any time. The real weight of the deposit (M) is easily calculated from the apparent weight (m) by the formula

$$M = \frac{m\,\Delta}{\Delta - \delta}$$

where Δ is the density of the deposit—which need not be known with very great accuracy—and δ that of the electrolyte. Instead of attaching the cathode to a balance pan, it may be suspended on a delicate spring balance furnished with a scale, or, as suggested by Dr. Perkin, it may be suspended on a helical ribbon to which a pointer is attached (as in the old Ayrton-Perry meters), and thus indicate continuously. Such an instrument, used with a suitable shunt, may be converted into a laboratory type of coulombmeter, as an accuracy of 1 per cent., and even 0·5 per cent. with care, can be generally obtained. It can, moreover, be easily adapted for the use of students in testing and illustrating the laws of electrolysis. Prof. Gee is at present engaged in determining the density of various electro-deposited metals by means of this "suspended electrode" method; it offers ready and obvious advantages over the direct determination of the densities of the stripped deposits. A number of experiments have been made with a mercury cathode and anode, which are of interest as bearing on the use of mercury in supply meters. The electrolytes used were solutions of mercurous nitrate, or mercuric chloride mixed with potassium cyanide. The mercury cathode was enclosed within a shallow dish suspended in the electrolyte by a platinum wire, the anode being a layer of mercury at the bottom of the containing vessel. In the case of mercurous nitrate it has been shown that the current efficiency as a monad is affected by the presence of mercuric and basic compounds.

Electrolytic Oxidation.

Dr. F. Mollwo Perkin and Mr. H. D. Law presented a second instalment of their valuable studies on the oxidation of hydro-carbons of the benzene series, dealing in this instance with ethyl benzene, cumene, and cymene. Apart from the possibilities which researches like these suggest for the future industrial employment of electricity in the chemical arts, this work appeals, of course, only to the organic chemist, but it is of interest to note here, as a general outcome of the authors' investigations, that the oxidation is not of a secondary, purely chemical nature, but is a primary electrolytic reaction, the hydroxyl ion being the oxidising agent.

Heat Conductivity of Furnace Materials.

Of more immediate interest to the engineer are the measurements which Mr. R. S. Hutton and Mr. J. R. Beard have made on the relative heat-insulating qualities of some of the commoner materials used in the construction of furnace linings. In spite of the great technical importance of such data, there are very few figures at present in existence to guide the scientific designer of furnaces, and the result has been that specifications for furnace materials have not, as a rule, even contained mention of the heat conductivities of the material that has to perform the all-important function of keeping the heat in the furnace. For the measurement of thermal conductivities of granular materials up to 100° C., a simple apparatus devised by Lees and Chorlton was employed. The chief results of these experiments are summarised in the following table:—

	Conductivity.
Sand (white Calais)	·00060
Carborundum	·00050
Firebrick	·00028
Retort graphite	·00040
Lime	·00029
Magnesia (fused)	·00047
Magnesia (light calcined)	·00016
Infusorial earth	·00013

In the more important measurements of the relative insulating powers of the materials at high temperatures, a small electrically heated tube furnace was made use of. This consisted of an unglazed porcelain tube, with a heating coil of nickel wire, supported at the centre of a cylindrical water-cooled enclosure, the space between the heating coil and the inner wall of the enclosure being filled with the granular material under investigation. Measurements of the power expended and the temperature attained clearly showed the comparative insulating values of the materials examined. These can best be seen from the curves in the accompanying diagram (fig. 3, p. 235), which show the relation between the rise of temperature at the centre of the porcelain tube and the time during which the heating has been in progress in the various cases. On account of the long time required for the temperature to become quite constant, the current was reduced by a definite amount after a certain time; that is why the curves have taken the particular shapes that appear in the diagram. It is, of course, from the horizontal portions of these curves that conclusions must be drawn. It will be seen that in the case of firebrick, carborundum and sand, the preliminary heating was effected with 300 watts, and after the lapse of about two hours the power was reduced to 250 watts, being kept constant at this from 1½ to 2 hours, by which time the emperature had become almost constant. The curves for kieselguhr (infusorial earth) and light magnesia clearly show the very much smaller conductivity of these materials. With these two substances the preliminary heating was effected with an expenditure of only 150 watts, but, despite this, the rise in temperature was more rapid than with any of the other materials mentioned.

Unfortunately, neither light magnesia nor infusorial earth can withstand any high temperatures for long without losing their efficiency to a considerable extent. Both substances exhibit large shrinkage at high temperature, and their chief uses are likely to be limited to the external jacketing of furnaces lined with some more permanent but less good insulator. There is no reason, conclude the authors, why, by a judicious use of several refractory materials built up in a *stratified* form of construction, it should not be possible to employ such excellent insulators as infusorial earth without risk of the damage which is inevitable if they be permanently subjected to too high a temperature.

Impurities in Accumulator Electrolyte.

Mr. R. W. Vicarey's paper on "Storage Batteries and their Electrolytes" was a preliminary communication, to be followed, before being discussed, by more definite data confirming the main thesis of the author—namely, that the presence in any quantity of nitrogen compounds, and especially ammonia, "a dangerous and subtle enemy," in the electrolytes of lead storage batteries is in a high degree harmful, affecting adversely both the durability and efficiency of the cells. The effects of ammonia in its various combinations appear principally in two distinct forms: (1) in an excessive shedding of active material at the positive plate; (2) it becomes deposited upon the negative plate, and finally closes up the pores of the active material, thereby causing a decrease in efficiency varying from 10 to 60 per cent. in about 12 months.

The principal danger appears to lie, not in the use of nitrogen compounds in the formation processes, because these are, as a rule, by the best makers, entirely eliminated from the finished plates; but in the introduction of the undesirable element into the electrolyte by the careless or ignorant user, either in the acid itself, or—and this is the most frequent source of trouble—in the water which has continually to be added to make up for evaporation losses. The great difficulty, naturally, is to make the ordinary battery attendant realise what *pure distilled water* really signifies; even the so-called "distilled" water which the central station engineer takes from his boiler is hopelessly impure from the point of view of the accumulator. Less obvious sources of ammonia are the atmospheric surroundings of cells. Even ordinary air, and especially town air, may contain sufficient of the gas to become harmful after a prolonged period of continuous absorption; all the more important is it, therefore, to ensure that a battery should not be installed in the neighbourhood of any spot whence ammonia is likely to be evolved. The author quotes a grimly-amusing instance of a battery that was installed in a manure shed, and which went to pieces in eight months!

The author's extensive experience proves most conclusively that the necessity for the *absolute purity* of the electrolyte has not up to the present been adequately understood by the average user of storage batteries, or even by the average electrical engineer, and he even goes so far as to assert that 95 per cent. of battery failures are due to the impurities that have been allowed to creep into the acids or the waters of the electrolyte. Mr. Vicarey will have rendered substantial service to the electrical industry if his paper has the effect of making people realise why it is that the battery is so often the weakest spot in an electrical power plant, especially if it succeeds in convincing them how easily this unnecessary weakness may be eliminated.

We must reserve the consideration of Prof. E. Wilson's paper on "Alternate-Current Electrolysis" for a future date, as, although it was taken as read at this meeting, it has not yet appeared in type, and the discussion was, therefore, postponed until the autumn.

PARLIAMENTARY.

The Administrative County of London and District Electric Power Bill.

Tuesday, August 1st.

MR. R. E. HAWARD, continuing his evidence on behalf of the L.C.C., in reply to Mr. CLODE, said that he had carefully examined the proposed purchase clause of the promoters, and was of opinion that it would be very difficult to work. He did not think that the audit proposed by the company was at all satisfactory, and there was no proper safeguard that only effective capital expenditure would be the basis of purchase.

Cross-examined by Mr. FITZGERALD, K.C.: He admitted that it would not be proper to insist on words being put into a purchase clause which would prevent the undertakers raising the capital. It was true that hitherto power companies had not been subject to any purchase clause, but, in his opinion, electrical companies generally had been too well treated in the past.

Re-examined, the WITNESS said he did not think that the purchase terms of the Act of 1888 had prejudiced promoters in raising capital, seeing that between 12 and 15 millions had been raised in London alone under that Act.

Mr. FITZGERALD: Coupled with unlimited dividends.—WITNESS: Yes, and in this case the dividend is 8 per cent., and in addition all the profits they can get on the lighting.

Mr. L. Coward, K.C., then addressed the Committee on behalf of the L.C.C. He said he desired the Committee to appreciate fully the attitude of the Council towards the Bill. They appeared there in the interests of London as a whole. They did not desire to advance their own claims to be constituted the central authority either for the production or the distribution of electricity; they simply asked the Committee to consider whether the Bill was so free from all serious objection and danger that it was expedient it should be passed. During the past seven years the Council had had before their minds the two main points which were raised by the present investigation—first, the question of a supply of electricity in bulk, and, second, the question of re-arranging and co-ordinating the existing areas and systems of electrical supply, so as to adapt those areas to the modern conditions of electrical production. With those objects they had held conferences—one in June, 1898, and one in May, 1901, between representatives of the Council and all the various metropolitan authorities—and at those conferences the conclusion come to was that the Council should obtain statutory powers to give a bulk supply to such local authorities as might desire to take it, and that the local authorities might be empowered to exercise their right of purchasing the existing companies in combination with one another, or by transfer to the L.C.C. In 1902 the Council introduced their Bill, which sought to empower them to supply local authorities in bulk—in other words, by that Bill the Council would have been placed, had it passed, in much the same position as that which the promoters of the present Bill were seeking to obtain. The Bill of the L.C.C. did not pass. It was opposed very strenuously by the companies, but it was somewhat noticeable to find that the opposition of the companies had been surmounted here. The L.C.C. promoted a similar Bill in 1903, which, however, was withdrawn at the suggestion of the Government, who said that they thought the question was one of such general importance that they intended to bring in a Government Bill to deal with the matter. Accordingly a Government Bill was brought in in 1903, and re-introduced in 1904, when it passed the Upper House, but got no further. The same Bill had again been introduced this Session. All of those Bills contained similar proposals. Under the Government Bill of this Session, under Clause 3, Sub-sec. E, the Board of Trade might, by provisional order, authorise any local authority to supply electricity in bulk to any other local authority; and by Clause 11 of the Bill the existing restrictions which prevented authorised undertakers from uniting with one another for the purpose of giving a bulk supply was removed. Mr. Fitzgerald had said that that clause was not intended to apply to the L.C.C., but they could only take the Bill as it stood, and as the Council were a local authority, it was clear that they would be able to supply in bulk. If the Bill of the L.C.C., or either of the Government Bills had been passed, it was extremely doubtful if the present Bill would ever have been seen. It could not be said that the delay was the fault of the L.C.C., inasmuch as three years ago they introduced their Bill under which they sought to do all that the present promoters proposed. The constant cry of the promoters was the benefit they were going to confer upon consumers, but he (learned counsel) could not see how the individual consumer was going to be benefited under this Bill. Under Clause 49 Sub-clause 3, if the Bill passed, they would be able to supply railways, docks, tramways, &c., throughout both the industrial and the non-industrial area, and under another clause they could, within the industrial area, give a direct supply to the consumer, either with the consent of the authorised distributors for the district, or if that were refused by leave of the Board of Trade. Therefore so far, at all events, as the benefit to the consumer in the non-industrial area was concerned, the prospect did not seem to be very hopeful—he was still to be left to the mercy of the existing authorised distributors, and that position had not been bettered one whit by the agreements which had been come to. The light consumer would not get any benefit, for even if the promoters took over the existing undertakings, they could charge the old prices for lighting. The most serious question for the Committee to consider was, whether if the Bill were passed it would not enable the promoters gradually to get into their hands the entire business not only of the production of electricity, but also of the distribution of electricity throughout the entire area. If that were the result of what this Bill was going to do, then the L.C.C. most respectfully claimed that the greatest caution should be observed before so great a power was entrusted to one set of men. He submitted that it was contrary to public policy to place the industrial fate of a large area like London at the mercy of one gigantic corporation. They had to consider the company as a distributing company, and their prices, as based on the cost of production, were either lower than those of the existing distributors or they were not. If they were not lower, then it seemed to him that the Bill was valueless; but if they were lower, it was perfectly clear that they could outbid existing undertakers for power business, and they must inevitably drive their competitors out of the field. It might be said that the Board of Trade would protect existing distributors, but it was not seriously contended that it would. Again, on the subject of monopoly, it might be said that the primary object of the promoters was to supply existing distributors and not the consumer direct, but in that case how was the consumer going to obtain the promised cheap supply? Even if the agreements that had been come to with the existing distributors provided that they should not charge more than the promoters' maximum price, there was nothing to prevent the existing distributors from charging the full 1½d., and he should think it was perfectly clear that they would do so. On the other hand, if there were no provision regulating the price to be charged by the distributing company, then the distributor could charge the present authorised price under his own orders. In either case, what became of the promised ¾d.? It was very dubious. Electricity was becoming more and more a necessity, and he contended that modern legislation was strongly opposed to placing the control of one of the necessities of life in private hands. Referring to the question of purchase, learned counsel contended that the proposed purchase clause did not say that the company was to be purchased at all. By the admission of the promoters this Bill did not come within the purview of the recommendations of Lord Cross's Committee in respect to the exemption from general purchase, and therefore he did not see why they should be relieved from the ordinary term of purchase which applied to all other electrical companies. In conclusion, Mr. Coward said that the L.C.C. felt that the great question of principle involved in the Bill, and the vital effect it must have on the future of London if passed, required the most earnest consideration and the fullest inquiry, and it was for the Committee to consider whether this great power should be entrusted to private hands at all.

The Chairman: Parliament decided to send it down to this Committee.

Mr. Coward: Yes, and it is quite open to you now that you have heard the views of the L.C.C. to say that you do not think that this Bill should proceed.

Mr. Macinerney then addressed the Committee on behalf of the Hackney Borough Council. He said that the Council had got their works cost down to a price which was never heard of before in London, and they had shown a surplus during the last three years' working of over £13,000. They had rejected the offer of the promoters because they believed they could do much better themselves. They had developed the power supply as much as it was possible to do. They quite admitted that the supply of electricity could be cheapened, and if the offer of the promoters had been made five years ago they would have considered it a splendid offer. Made now it looked pretty well, but when it was considered in regard to five years hence, when the development which Mr. Merz talked about had come to pass, the figures that now appeared so plausible would be entirely too large. It occurred to them that following the course of the development of electricity, this was not a good time to enter into a hard and fast bargain for the price of electricity in the future. For the three years they had been trading they had been coming straight down. Mr. Merz had said that the price would go down by leaps and bounds. He (counsel) agreed, but it would come down as much for municipalities as for this company.

Mr. Spencer Hawes, a member of the firm of Robert Hammond and Sons, consulting engineers to the Hackney Borough Council, said that he and his firm had been engaged for the last 15 years in carrying out schemes to the extent of over 2 million sterling, including besides Hackney, Leeds, Dublin and other places. Hackney had spent £274,000 on its electrical undertaking. The works had been in operation three years, and for each of those years it had secured the lowest working costs of any undertaking in the Metropolitan area. The working expenses per unit sold for the year ended March 31st, 1905, were ·88d. Such a figure had never before been realised in London. The present capacity of plant in use was 3,372 kw. They had altogether a site of 5 acres, in which he thought they could provide for 50,000 kw. if necessary. They had had an offer from the promoters to give them a supply in bulk. That offer had been carefully considered by the Electric Lighting Committee and also by a special sub-committee consisting of the chairman, the town clerk and the engineers, and after going very carefully into the matter, the Committee were bound to decline to entertain it on the ground that it would not be to the advantage of the Council or the consumers in Hackney.

Wednesday, August 2nd.

At the commencement of the proceedings on Wednesday, Mr. Fitzgerald, K.C., said that, on behalf of the promoters, he had, most unwillingly, to make an appeal to the Committee. He was informed by the Parliamentary agent that, unless the case were finished by the next day, there was considerable danger of the Bill being lost by the effluxion of time, and under these circumstances he asked if the Committee would sit late. He was aware this might put the Committee to great personal inconvenience, and must undoubtedly increase the strain which these proceedings of necessity had. It was only on account of the late period of the session, and having regard to the amount of time which had already been spent on the Bill, and the very large expenses which had been incurred by all parties, that he made the appeal, for it would be a great misfortune if the Bill were lost simply owing to there being insufficient time.

The Chairman said it was naturally a great strain on the Committee owing to the great interests which were involved. He did not think there had been any unnecessary prolongation of the proceedings. They would be prepared to sit late that night and early the following morning. They realised the great charges on one side and the great interests on the other. The Bill had attracted very much attention in Parliament, and he felt the responsibility very much of doing everything he could to advance the proceedings, but they must give every interest full opportunity.

Mr. Fitzgerald said that with regard to the agreement with the South London Electric Lighting Co., the inaccuracy which had been referred to had now been corrected. The clause was substantially the same as those agreed with other companies.

Mr. W. J. Bullock, engineer for the West Ham Corporation, was called and examined by Mr. Morton. He said that the Corporation had now a large generating station and owned the tramways in the borough. The plant installed had a normal rating of 5,700 kw, and they had already installed additional boilers in view of the extension of plant. They could get slack coal alongside their wharf at 7s. a ton, and rough small coal at 7s. 6d. a ton. They were actually paying 7s. 10½d. a ton for similar coal to that which Mr.

Merz proposed to use. They had plenty of room for extension, plenty of water for condensation, and cheap coal, which were the three things that Mr. Merz relied upon. They had a considerable amount of public and private lighting, a considerable traction load for the tramways, and if they got a good power supply they would get that diversity of load which produced a good load factor, and enable them to reduce the cost of lighting. Their estimated total capital cost of a capacity of 18,000 KW. installed in the present buildings was £270,426 made up as follows:—Land, buildings and foundations, overhead coal bunkers, &c., £70,000; chimneys, flues, boilers, piping, fans, condensing plant and auxiliaries, £75,976; generating plant, £110,348; switchgear and sundries, £6,183; extras and supervision, £7,919. They had done all they possibly could to promote the use of power, and they offered consumers energy for power purposes in the first instance at 1d. per unit. They were supplying the Thames Iron Works with a large amount of power. In 1903 they sold 154,000 units for power; in 1904, 212,000 units; in 1905, 300,000 units; and they estimated that this year they would supply 1,500,000 units. They had over 100 miles of electric mains laid in the borough now, and had spent over £70,000 thereon. Witness put in the following table showing the yearly increase in the power supply:—

Year ending	Total horse-power added per year.	Power units sold.	
		General supply.	Traction.
March, 1902 ...	132	141,537	—
„ 1903 ...	129	154,090	—
„ 1904 ...	120	212,390	23,740
„ 1905 ...	333	300,037	1,444,394
„ 1906 ...	Applied for, 389 Estimated, 1,500	1,300,000	3,000,000

1905. Total horse-power, 714 Total power units sold, 1,744,431
1906. „ „ 2,603 „ „ 4,300,000

Witness further put in the following table, showing the growth, &c., of the borough undertaking:—

replace your antiquated machinery?—I do not think it antiquated.

I am using Col. Crompton's description.—We do not intend to scrap our present generating machinery.

Then you won't produce at the lowest cost?—No.

Mr. Morten addressed the Committee, and said the Bill was absolutely useless for the Borough of West Ham. Mr. Merz had told them that if they were to produce electricity cheaply they must have a site where they could get a good supply of water, cheap coal, and where they had room for extension. Well, they could get coal that day into their bunkers at the cost of 8s. 6d., and that compared with Mr. Merz's 8s. 4d. There was no doubt that they could get coal as cheaply as Mr. Merz could get it. They had an ample water supply, and they had actually got the buildings erected in which they could install additional plant for future demands. It was true that the actual generating cost of the station of that size might be more than the generating cost of the large stations of Mr. Merz, but the generating cost was not the only thing to be borne in mind, for the cost of distribution was quite as important as that of generation. They had an area far better suited for the purposes of distribution than the area proposed in this Bill. It was an area of 7¼ sq. m., and there was a population of 300,000. They had spent altogether £315,000 on the electricity undertaking, which would be a heavy charge on the rates if their stations had to be scrapped. He submitted there was no necessity for the scheme, and no possibility of its being a success.

Mr. A. Gay, engineer to the Islington Borough Council, was called by Mr. Saunders, and, replying to questions, said the cost of the generating station at Islington was about £217,000, and the cost of the distributing system something over £200,000. The existing machinery installed was 3,600 KW., but they were installing a turbine generator of 1,500-KW. capacity, including condensing and all accessory appliances; that would cost £15,000. In 1896, when they first began to work, they sold 297,864 units, and in 1905 they sold 2,609,000 units. Power was first sold in 1902, and in that year they sold 24,154 units for power. In 1905 they sold 406,369 units for power. The generation cost per unit in 1896 was 3·32d., and in 1905 it was 1·56d. per unit. They showed a loss on the undertaking in the earlier years, but in 1905 they showed a profit of £4,574.

County Borough of West Ham.—Electricity Department.

Year ending.	Total units generated.	Units sold.					Units used on works.	Costs per unit generated.		Costs per unit sold.		Load factor.
		Public lighting	Private lighting.	Power.		Total.		Works.	Total.	Works.	Total.	
				General.	Traction.							
March, 1900... ...	741,435	152,699	420,093	—	—	572,792	23,208	1·65	2·01	2·14	2·60	11·31
„ 1901... ...	1,246,585	179,726	693,732	40,878	—	914,337	36,446	1·55	1·92	2·12	2·62	10·84
„ 1902... ...	2,021,463	265,583	1,176,301	141,537	—	1,583,421	51,118	1·36	1·50	1·70	1·92	12·82
„ 1903... ...	2,632,100	322,970	1,453,503	154,090	—	1,930,563	41,077	1·21	1·42	1·65	1·94	13·91
„ 1904... ...	2,800,460	375,764	1,614,921	212,390	23,740	2,226,815	42,748	1·31	1·58	1·65	1·99	13·08
„ 1905... ...	5,029,736	650,797	1,796,903	300,037	1,444,394	4,210,447	100,000	·79	·95	·949	1·133	18·70
„ 1906... ...	7,850,000	800,000	1,900,000	1,300,000	3,000,000	7,000,000	180,000	·59	·72	·66	·81	26·60

The estimated units sold for 1906 are based chiefly on applications already received; the works costs are based on present costs of production.

He thought it was very possible that Mr. Merz would be able to generate more cheaply, but he would have the cost of distribution to make up, and he did not think there would be any real advantage to West Ham in the passing of the Bill. West Ham had as compact an area as it was possible to have. They had the works of the Great Eastern Railway, the carriage works of the London and Tilbury Railway, the Victoria Dock, and a large portion of the Royal Albert Dock in the area, all of which would be capable of being big consumers of power, and he thought it would be a hardship if unlimited competition were allowed. The Borough Council were in a position by agreement to get a supply of electricity in bulk from the Charing Cross and Strand Co. if they wanted it. Witness put in the following table showing the estimated revenue account when the sale of current reached 8,500,000 per annum. He estimated that the sales for 1905-6 would reach 7,000,000 units, and it was therefore reasonable to assume that units sold would reach 8,500,000 by the financial year 1907-8.

Expenditure.		Revenue.	
Generating costs:—		By sale of 5,725,000 lighting and traction units at 1·68d. per unit.	£40,017
10,000,000 units generated at 0·416d. per unit	£17,333	By sale of 2,775,000 power units at 0·7d.	8,094
Distribution	2,000		£48,111
General expenses, management rent, rates, taxes, insurance and sundries	4,225	Deduct expenses	34,193
	£23,558		£13,918
Sinking fund on capital of £322,300 at 3·3 per cent. ..	10,635	Which is equivalent to 4·3 per cent. on average capital for the year of £322,300.	
	£34,193		

Cross-examined by Mr. Fitzgerald, Witness admitted that about 50 per cent. of the total output was taken by the Corporation for the tramways, while about 40 per cent. was for private lighting. He did not admit, however, that the company would be unable to compete for this 90 per cent. The company would be able to compete indirectly by taking any of the remaining portion of their supply.

Mr. Rutherford (one of the Committee): Do you intend to

They charged 3½d. per unit for public lighting, but street lighting covered the peak of the load, and necessitated a larger amount of machinery. In addition, there were special mains and conduits, and the whole system, to an extent, was an independent one. In the case of power, no additional machinery was required. It might be looked upon as the by-product of the undertaking except for the small expenditure for feeders, &c. In 1902 they charged 2d. per unit for power.; in 1903, 2d.; in 1904, 1·68d.; in 1905, 1·63d.; and recently it had been reduced to 1d. Their station was close to the Great Northern Railway, and they got their coal direct from the colliery. It cost them 9s. 7d. a ton.

Cross-examined by Mr. Lloyd, K.C., Witness said the average charge for power last year was 1·75d., and the cost per unit was about the same. He did not agree that it cost them more to generate for power than they got for the energy. The company had made the Corporation an offer, and he agreed that on the present figures it would save the Corporation £3,000 a year. He would consider such an offer, but questioned whether he would accept it, for he believed that by economies they would be able to supply themselves cheaper. Out of their total supply they used 1,078,921 units for public lighting. It was true that the auditor had called attention to the cost of public lighting, but the district was getting good light. He had reported to the Council that the effect of reducing the price for power to 1d. would, on the present supply, mean a loss of £1,000, but he looked forward to a recoupment from an increased demand.

Mr. Saunders addressed the Committee, and contended that there was no demand in Islington that the local authority could not meet. The promoters alleged that the whole of the existing stations ought to be scrapped, but at the same time they were making agreements with different people for the retention of the stations.

Mr. A. H. Shaw, resident electrical engineer to the Ilford District Council, said the Council began to supply in 1901. The total units which they had generated had steadily increased, and last year they were over 2,000,000. Of this about 500,000 was for public lighting and 500,000 for the tramways. Their maximum load had gone up to close under 1,200. The works cost had decreased from 1½d. in the first year to 1d. last year. They charged 3d. for light-

ing and 1½d. for power. The revenue from power last year was £926. They had a plant of 2,600 KW. capacity, and this gave them a large surplus for the future demands of the district.

By Mr. FITZGERALD: 66 per cent. of their output was sold to themselves, and a company could not touch that. Their revenue for power only increased by £6 from 1904 to 1905. Their cost per unit came to 2·2d. including all charges.

Mr. BENTON, clerk to the Ilford U.D.C., also gave evidence.

Mr. VESEY KNOX, on behalf of the Ilford U.D.C., addressed the Committee, and urged that no competition should be allowed. They did not want the threat of competition, because it would seriously affect their business.

Thursday, August 3rd.

Mr. MYERS having addressed the Committee on behalf of the Battersea Borough Council, called Mr. T. W. A. HAYWARD, surveyor for Battersea, who spoke strongly against the proposal of the promoters to lay a main conduit through Battersea. He said that all the roads in Battersea were now as full of pipes as they could be.

Mr. W. A. KEMM, electrical engineer to the Borough Council of Battersea, said that the local authority became the lighting authority under a provisional order in 1896. In the first year of working of the electrical undertaking, they made a loss of £3,850; in the second year a loss of £2,426. In the year ending March, 1904, they made a profit of £24, and for the year ending March, 1905, a profit of £900. That was after paying sinking fund and all charges. The average price obtained for the supply of light at the beginning, had been 5·31d.; in 1902-3 it was 3·57d.; in 1903-4, 3·07d.; and for 1904-5, 2·81d. The present charges were 4d. for light and 1d. for power. The capacity of the present station was 2,000 KW., and they were increasing that by another 1,000 KW. set. They had room for extension in the present building to 7,000 KW. At present they were supplying 900 H.P., and the total estimated horse-power used in the borough was 5,000. The maximum load for 1905 was 1,350 KW., and he thought that 4,400 KW. would not be an excessive estimate for 1910. They charged 1½d. for power to small consumers, but they hoped to be able to reduce it to 1d. for all.

Mr. FITZGERALD, K.C., handed to the Committee agreed clauses with the Lambeth Borough Council, the South London Electric Supply Co., and the City of London Electric Lighting Co., and at a later stage of the proceedings, he handed in agreed clauses with the Gravesend Corporation and the Richmond Electric Light Co.

Mr. BLENNERHASSETT, K.C., on behalf of the Westminster City Council, put the case of that Council before the Committee, and said that there were no fewer than seven companies authorised to supply in Westminster, all of which became purchaseable by the City Council in 1931, while they were also able to purchase the Marylebone generating station of the Central Electric Supply Co. It would, therefore, be seen that in 1931 the City Council would be enabled to purchase a complete undertaking equal to meeting all the needs of the district, and obviously they were most anxious that nothing should be done which would hamper or burden the City in 1931. The Power Co. was able, under two clauses, to enter into agreements with existing undertakers, and it would be possible for the company to obtain control of these companies, and so set at naught the policy of Parliament, as set forth in the Electric Lighting Acts.

Mr. EDWARDS (a member of the Committee) asked if the learned counsel suggested that the right of purchase would be interfered with.

Mr. BLENNERHASSETT said he hardly meant that. What he contended was that the introduction of this power company into the area would render the purchase valueless.

The CHAIRMAN pointed out that there was nothing which would prevent the City Council putting up their own generating station.

Mr. BLENNERHASSETT said, if they did that, it would deprive them of all the benefits of purchase under the Electric Lighting Acts. The result of the passing of the Bill would be to put the existing electrical undertakings of London in the position of mere distributors, and the Westminster City Council was not willing to be a mere distributor for electric light. The name of the Electric Lighting Acts was a misnomer, for they should have been termed the Electric Supply Acts. These Acts dealt with the whole question of electric supply, and the Westminster City Council claimed to take full advantage of them. A point had been made by the promoters that there was no company at present in Westminster which had the power to supply a railway, but there was no reason why, when the undertakings came into the hands of the local authority, they should not be able to do this. If the Bill were allowed to pass at all, he asked that the company should be restricted to supplying authorised distributors in bulk in Westminster. A further matter of grave concern to his clients was the breaking up of the streets which would be necessitated by the introduction of a new company into the city, for while it was true that the Board of Trade would have the right to say what routes should be followed, yet their experience in Westminster was that the Board of Trade paid more attention to engineering questions and public safety than to interference with traffic. In this matter he would certainly prefer the arbitration of the Local Government Board.

Mr. Alderman EMDEN was called, and gave evidence as to the chaos which would result from the breaking up of the streets in Westminster. The Council objected to a non-purchaseable company coming into their district.

Mr. J. HUNT, the town clerk of Westminster, gave similar evidence. In cross-examination, witness admitted that there was no company at present which could supply any new tube railway which might be constructed in Westminster.

Mr. J. W. BRADLEY, engineer to the City of Westminster, also spoke of the interference with the streets by various statutory companies. There was great difficulty now in finding room for the existing companies, and certainly no room for the mains of a new company.

Mr. C. C. HUTCHINSON said he would call no evidence on behalf of the Borough of East Ham. That authority were the undertakers for electricity in the district, but their revenue at present for power was only £177. There were only two large works in the district, viz., the Gas Light and Coke Co., and the Albert Docks, and with regard to the latter concern 90 per cent. of any supply they might take would be used for lighting, which it was the right of the local authority to supply. The district was developing a number of small factories, and these he claimed he ought to be allowed to supply. The whole foundation of the promoters, however, was to obtain the supply of power whether in conjunction with the authorised distributors, or in spite of them. If the Bill passed, he was afraid Mr. Merz would get into his district, owing to his having to carry his main through East Ham to supply Barking, which would be unremunerative. Under those circumstances the company would inevitably capture East Ham, and, further, they would endeavour to encompass East Ham by trying to get them to take a supply in bulk. Unless the local authority came willingly, Mr. Merz would gobble them up body and soul, and he would take away the power supply to the small factories and the supply to the docks. The real object of the Bill was monopoly and nothing else, and of that they had had an object lesson each morning when his learned friend, Mr. Fitzgerald, came in like an Indian chief surrounded by his young braves, and exhibited with pride the scalps they had captured in the way of agreements over night. They were making agreements with the companies in London for a joint policy, which would secure them a monopoly of the London electric supply. He contended that the comparison of the capital cost of the existing generating stations and the cost at which Mr. Merz could equip them was unfair. The figure of £50 did not represent the cost of plant now actually in existence, but it represented capital spent on years of experiment. He asked if some consideration was not to be given to those who had borne the heat and burden of the day in arriving at the present development of the electrical industry. He ridiculed the idea of the purchase clause being a serious one, and if there were a clause which seriously safeguarded the interests of the existing undertakings, the promoters would want financial support from the public.

Mr. C. MUNROE, having addressed the Committee on behalf of the Shoreditch Borough Council, called

Mr. MANSFIELD ROBINSON, the town clerk, who described the undertaking in the borough, which was a combined refuse destructor and electricity works. It was estimated that last year the steam from the destructor generated 800,000 units. He denied the statement that they did not cater for power users, for their works had been laid out for a power supply, and they had done all they could to get customers. The Shoreditch undertaking had not cost the rates a penny. They did not object to competition on fair terms, but they objected to unfair competition, and he contended that the competition of the company would be unfair. As an illustration of what he meant, witness pointed to the fact that the company proposed to pay interest for four years out of capital, whereas the local authority had to pay interest during construction.

By Mr. LLOYD: It was true that at a conference of London boroughs he proposed a resolution that there should be a large municipal bulk station on the River Thames. The company had made the Council an offer to supply at ·95d., but it was calculated that that would involve the local authority in a loss of £5,000 a year.

Mr. C. NEWTON RUSSELL, electrical engineer to the Shoreditch Borough Council, said they had two generating stations with a capacity of 3,645 KW. and a 20 per cent. overload. They had room in the building and sufficient land to install a further 8,000 KW. Last year they sold 3,536,497 units, of which one-third was for power. They supplied 55 per cent. of the power used in the district, but none of the factories had anything like a load factor of 42 per cent., which the promoters estimated to get. The highest load factor of the consumers they supplied was 22 per cent., and the average was 15 per cent.

Mr. C. H. WORDINGHAM was called, and confirmed the evidence of the last witness.

Mr. VESEY KNOX then addressed the Committee for the Southwark Borough Council and the Dartford U.D.C. He pointed out that the Kent Power Co. was prevented from getting into Dartford without the consent of the local authority, but, by an agreement with the Administrative Co., the latter would share any profits with the Kent Co. of any business done in Dartford, should the Board of Trade allow them to come in. In Southwark the circumstances were somewhat peculiar, inasmuch as there was considerable competition between two companies in one part, and between a company and the local authority in another part. It would therefore be unfair to sanction further competition. He contended that the agreements which the promoters had made with the companies working in Southwark were for the purpose of getting into the district without the consent of the local authority.

Mr. C. MUNROE, on behalf of the Bermondsey Borough Council, the Lewisham Borough Council, and the Leyton U.D.C., addressed the Committee. He said that in 1899 the Bermondsey Borough Council obtained an electric lighting order. The London Electric Supply Corporation supplied over the whole of the area. In one portion of the borough there were two companies in competition, viz., the London Electric Supply Corporation, and the County of London Co. When the Borough Council went to Parliament and asked for power to

supply in this portion they were refused on the ground that there were two companies in competition there, but now that Committee was asked to reverse that precedent and allow a third company to come in. Here they had two companies supplying in one district, and he protested against the streets being broken up to lay further mains. It was said there could be no competition for lighting, but it would be possible for a man with an eight-roomed house in Leyton and a workshop in the back garden to take a 1-H.P. motor, and the margin allowed for lighting would be ample for him to light his premises. Leyton had spent £141,000, and Bermondsey £110,000 on their electrical undertakings, and if this Bill passed that money would be in jeopardy. It was true that the Leyton undertaking had not been very successful, but two tramways were just falling in, and when the local authority was supplying these it would be a great success. Lewisham had no undertaking of its own, but was supplied by the South Metropolitan Electric Supply Co. The district was served under three different orders—viz., the Blackheath Order, the Lewisham Order and the Crystal Palace Order, and these became purchaseable at different dates. If the company got in, when the local authority came to buy, the undertaking under these orders would be gone.

Mr. RAM, K.C., for the Metropolitan Electric Supply Co., said he wished to address the Committee on the new clauses introduced, by which he contended that the company wished to get into the area of his company. Lord Camperdown's Committee over and over again stated that they would not allow any infraction of the frontiers. The promoters, however, were seeking for power to supply in bulk to the Charing Cross and Strand Co., for use in any of their districts, and that would mean its being used in the district of the Metropolitan Electric Supply Co. The Bill was altogether a different Bill to that which left Lord Camperdown's Committee. Clauses were rushed in, and he confessed that even with regard to his own company, he found it difficult to say how he was affected.

The Committee rose at six o'clock, having sat seven hours.

Friday, August 4th.

At the opening of the proceedings on Friday, Mr. BALFOUR BROWNE said that at a late hour the previous day Mr. Ram addressed the Committee with an ingenious and fiery speech. Mr. Ram had no right to make that speech, for he was simply concerned in clauses. He thought Mr. Ram had stolen a march on the Committee.

Mr. RAM said he was petitioning against the Bill, and it was to that petition he addressed his remarks.

The CHAIRMAN: Mr. Ram was very ingenious. He was like another gentleman who said he had only a word or two to say. I timed him, and he spoke just one hour.

Mr. A. C. MORTON, chairman of the Streets Committee of the City Corporation, gave evidence, and said that two companies supplied the City. The City had benefited by such competition. The Corporation were strongly opposed to the Bill. They objected to the creation of a monopoly which would enable a company to exploit London, and leave London in the same position as they were with regard to the water companies. He endorsed Mr. Mackinnon Wood's evidence with regard to the purchase clause. In his view the agreements which the company were making with existing companies meant monopoly. He was of opinion that any such agreement affecting the companies supplying in the City should be subject to the approval of the Corporation. Another thing they feared if the Bill were passed was that neither the existing companies nor the local authorities would be allowed to extend their works owing to the existence of the company. Witness proceeded to deal with the congestion of the streets, and said the company ought not to be allowed to carry their mains through the City. The Corporation thought before dealing with this question there should be a Royal Commission to inquire into the whole matter.

Sir R. LITTLER, K.C., addressed the Committee, and urged that the City should be left out of the scope of the Bill. When the promoters were before the other House they posed as philanthropists, but now they found them making terms with one body after another, and they had eventually bought off a considerable amount of competition. Was not that buying off of opposition, however, a condemnation of the scheme? The Corporation had the right of purchase of the undertakings of both companies in their area, but if these two companies were to scrap their works and take a supply in bulk from the Administrative Co., what would be their position then? It appeared to him that the Corporation would be deprived of those advantages which Parliament had given them. He thought that the purchase clause alone was so unsatisfactory as to form a strong reason for rejecting the Bill.

Mr. FITZGERALD, in reply, said he would deal only with the salient points brought before the Committee. A good deal of criticism had been addressed to the actual provisions of the Bill, but that was founded on misapprehension. A great many objections had been made to clauses, but there must be some finality in those matters, and when promoters found clauses passed by Parliament and inserted in other Bills, they were justified in taking them and putting them into their Bill, and those clauses ought not to be criticised as if they had never been passed by Parliament. In the other House the Committee was anxious to protect the interests of the authorised undertakers, whether a company or local authority, and they amended certain clauses with that end. So far as the standard clauses had been departed from, it was so as to give additional protection to the authorised undertakers, and an additional advantage to the consumer of power. There was a clause in the Bill known as the "Stand-by Clause," which had been attacked over and over again by the local authorities; but what was the history to that clause? It was settled last year by a Select Committee of the House of Lords on a Government Bill after a most careful consideration, and supported by the local authorities all over the country, including the borough councils of London. Now they found the borough councils attacking that clause which was settled last year. Let him take Clause 71. The promoters of the Bill did not invent that clause, but it had been passed by Parliament over and over again. In the case of the Clyde Valley Bill, the clause was not inserted originally, but the company came back to Parliament a few sessions afterwards and asked for the clause, and it was given them. The object was not to buy all the London companies, for that would require millions of capital which they had not got. The fact was that in a large area like this there were certain small undertakers who could not carry on their business with success. Barking was a case in point. Under Clause 71 they would take over that undertaking and charge prices which would be much more beneficial to the consumer than the Barking U.D.C. would be able to give. It was not a transfer which in any way affected the public interest. It was not the case that under the Bill advantages were given to the large consumer which were not given to the small consumer, for the maximum prices referred equally to the large and small consumer. Nor was it true that there was any picking or choosing. If by permission of the Board of Trade the company went into a district where the local authorities were the suppliers of electricity, they went in under exactly the same conditions. With regard to the remarks of Mr. Ram, it was not a fact that the provisions of the Bill had been vitally altered.

The CHAIRMAN said if contracts had been made and a company were taken over, he supposed the contracts would be taken over too.

Mr. FITZGERALD said that Mr. Ram had said that the effect of the agreements they had made was to deprive the consumer of the right he had now to get a supply of electricity. There was absolutely nothing in that statement. The agreements they had made provided for this—that for the extra supply of electricity they required beyond what their existing stations could give, the companies came to them and got a supply at a price which was lower than they could generate at themselves. There was no obligation in law for an undertaker to put up a generating station. The obligation of the undertaker was to supply, and if he could get a supply in bulk from another person, he could fulfil his obligation. The real reason of Mr. Ram's grievance was that the County of London Co. were supplying in competition with the Metropolitan Co. in one of their areas, and he thought that under the agreement which the County of London Co. had made with the promoters, they would get electricity cheaper than they could generate it at themselves, and would thereby be more effective competitors with his company. That was the reason for the Metropolitan Co. interfering in this Bill, and upsetting the arrangement they came to in the other House. Under Clause 67 the Administrative Co. was entitled to give a supply to any undertaker whose undertaking was partly within, and partly without the area, and it enabled the undertaker to use the whole of that supply, whether within or without his area. Clause 68 enabled the company to give a supply to contiguous undertakers. Take the case of Fulham. That was within the area of the Metropolitan Co. as fixed by the House of Lords. Under that Clause 68, although Fulham was entirely outside his area, yet they might have given a supply to Fulham as being a contiguous authority. But it was agreed that that clause was not to be used to give a supply in the Metropolitan Co.'s district, and accordingly a proviso was added that the powers under that section were not to be used for giving supplies within the Metropolitan Co.'s area. But that arrangement was come to on the express understanding that it was not to interfere with the supply under Clause 67, and the very case of the County of London Co. was mentioned as coming under Section 67. He asked the Committee to look at the advantages London got by the agreements with the companies if the other companies adopted their maximum price of 1½d. instead of 7d. or 8d. The present average price for power was 2d. all over London, and that was prohibitive in the case of the small manufacturer. The bulk of the present business of electricity undertakers was the lighting business, but if they were to give power at a reasonable price, they must lay out their business for power, and not look upon it as a by-product. The power business of the existing undertakings was almost a negligible quantity. West Ham appeared to be a well-managed undertaking, but they found that for 50 per cent. of the output the Corporation were their own customers, and nearly the whole of the residue was private lighting, for which they could not be competed with. They were told that in 1910 West Ham could supply as cheaply as the company, and if that was the fact, then the company could never go into West Ham, because the Board of Trade would hold that it was unreasonable. Hackney was another case of an undertaking well managed.

The CHAIRMAN: Do you suggest that the Board of Trade will refuse to allow the Power Co. to enter in cases where the existing undertakings are prepared to supply at a low rate?

Mr. FITZGERALD thought that was so, for Clause 49 said the Board of Trade was to have regard to the price charged. If the case of the local authorities were correct there would be no competition at all, but he did not suggest that their case was correct. He thought it would be inevitably found that the company would be able to supply electricity at a cheaper rate than West Ham possibly could generate for itself, and, therefore, unless the West Ham people sunk their prices so as to supply at a loss, they would either make an agreement with the company to take a supply in bulk or the Board of Trade would allow the company to come in, and so benefit the consumers of the district.

Mr. EDWARDS: But if their case is true, you have nothing to gain?

Mr. FITZGERALD said if it were true that these local authorities

could generate as cheaply as they could there was no case for the Board of Trade. The experience of the whole world, however, proved that concentration of the generation of electricity meant generation at a lower cost. He was afraid that in the discussion the interests of the manufacturers of London had been somewhat lost sight of, but the fact remained that only 4 per cent. of the power used in London was supplied by the electrical undertakers. With regard to the authorised undertakers, the Bill gave them the valuable option of taking a supply in bulk from the company.

The Chairman said the case of Shoreditch appeared to be exceptional.

Mr. Fitzgerald said that was a case of the local authority being in possession. The bulk of their business was lighting, and they did not propose to compete for that.

The Chairman: But half the power in the district is supplied by them now.

Mr. Fitzgerald said if that were the case and their price was reasonable, the Board of Trade would probably refuse to allow the promoters to go into the district. In the other House they had a united opposition against them, but one by one the great majority of their opponents had come in.

Mr. Edwards asked what guarantees were there that those who had come in would take supplies.

Mr. Fitzgerald said in almost all. The companies agreed to get all the energy they required beyond what they could manufacture for themselves in their existing stations. With regard to the opposition of the London County Council, all they asked for was delay, and the City Corporation did the same. As to the purchase clause, the promoters had never varied from the statement they put before the House of Commons on second reading. If the Committee adopted the view that the undertaking should be purchaseable by a body to be created, then they would have to consider what the terms of purchase should be. Certainly the company ought not to be in a worse position than the electrical undertakers under the Act of 1888, under which they got a term of 42 years, and the value of their works at the end of that term, without allowance for goodwill and prospective profits. But they had no limitation of their dividend, and a very high maximum. In the Bill before them, they had a very low maximum, and also a sliding scale, and they asked that they should be allowed the actual capital expenditure as certified by the Local Government Board auditor. If the Committee thought there was any particular difficulty in auditing, he would accept a term of 50 years, with purchase at the end on the same terms as in the Act of 1888, provided that the promoters were allowed to create a sinking fund. Then the present companies and the power company would be on the same terms with regard to purchase except that the power company would have a term of 50 years, as against 42, and when they considered the large capital involved and the greater risk they were running, he did not think that was an unreasonable proposal.

The Chairman asked if the standard rate of dividend was the same as that fixed in other power Bills.

Mr. Fitzgerald said it was, but there was a great difference in the standard price. In the other Bill a standard price of 2½d. corresponded with 8 per cent., and in this Bill the standard price was ¾d.

The Committee retired, and on their return the Chairman said it was quite clear that, before they could decide on the preamble of the Bill, they must have the clauses before them. Mr. Fitzgerald had referred to a new purchase clause, and that would necessarily have a very important bearing upon the minds of the Committee in coming to a decision. He must ask the promoters, therefore, to submit the amended purchase clause, and then the Committee would consider it and give a decision on Monday.

Mr. Fitzgerald said he could give the new purchase clause at once. Unless they settled the matter, he was afraid it would be almost impossible to get the Bill through.

Mr. Coward, K.C.: Whose fault is that?

Mr. Fitzgerald then read the following alternative clause, and a new clause consequent upon it:—

Alternative Clause 79A:—"In the event of any public authority or body of trustees (hereinafter called 'the purchasing authority') being authorised by Parliament to acquire the undertaking at the expiration of a period of 50 years from the passing of this Act and of subsequent periods of 10 years thereafter, the following provisions shall apply and have effect (that is to say):—

"(1) Not less than 12 months' notice in writing shall be given to the company by the purchasing authority intimating their intention to acquire the undertaking.

"(2) Such purchase shall be made upon the terms of the purchasing authority paying to the company in respect of the undertaking, the then value thereof, as determined in accordance with the provisions of Sec. 2 of the Electric Lighting Act, 1888.

"(3) As from the date of purchase the undertaking shall be transferred to and vested in the purchasing authority, and such authority, to the exclusion of the company, shall have and may exercise all the rights, powers, authorities and privileges of the company, and shall be subject to all the duties, obligations, agreements and liabilities of the company in like manner as if they were the company, except the debt due by the company at the date of purchase, and the liabilities with respect to the debenture stock and mortgage debt of the company.

"(4) For the purpose of this section 'the undertaking' means all lands, buildings, works, materials and plant of the company suitable to, and used by them, for the purposes of their undertaking, but shall not include any insurance fund, reserve fund or sinking fund authorised by this Act, or cash in hand or at bankers, securities for money or any debts due to the company."

New Clause 61A:—"Notwithstanding anything in this Act contained, the company may before ascertaining the clear profits of the undertaking available for the payment of dividend, set aside such sums as they think fit to form a sinking fund, which shall remain the property of the company in the event of any purchase of the undertaking, provided that the sums so set aside in any year shall not exceed an amount equal to 1 per cent. per annum on the paid-up capital of the company for the year, and the aggregate of such sums shall not at any time exceed an amount equal to one-third of the paid-up capital of the company for the time being."

He appealed to the Committee to continue the sitting and give the Bill a chance to go through.

Mr. Blennerhassett, K.C., asked for time to consider the clauses, and said that if the Bill got through Committee it could go forward to next session.

Mr. Coward said the attitude of the promoters had vitally changed, and it was only reasonable that they should have some time to consider these new proposals.

The Chairman said the Committee were conscious of the vast importance time was to the promoters, and recognised the position they were in. He could not reproach the Committee with any neglect of duty, and there had been no undue prolongation on the part of the opposition. But the Committee felt it quite impossible to come to a decision without fuller consideration. He had consulted the authorities of the House, and knew the position and what the result of delay might be. It was with full consciousness of this and with a strong sympathy for the difficulties of the promoters which had arisen through no fault of their own, but in consequence of delays in the other House, that he adjourned the Committee till Monday.

Monday, August 7th.

At the outset of the proceedings, the Chairman asked that the various opponents should hand in their amendments. This having been done,

The Chairman said: It is now my duty to announce the decision of the Committee, which, by a majority, is that, subject to the consideration of clauses and amendments, they will report to the House that the preamble of the Bill is proved.

Mr. Kennedy, Parliamentary agent for the promoters, then went into the witness chair, and the Bill was considered clause by clause. Clauses 1 and 2 were allowed to stand part of the Bill.

On Clause 3 Mr. Morton, for West Ham, raised the question of nuisance from smoke, submitting an amendment to deal with this. If there was to be no nuisance, he thought that the promoters ought to agree to his amendment.

The Hon. J. D. Fitzgerald, K.C., said the provisions in the Bill were similar to those in all power Bills, and followed the recommendations of Lord Cross's Committee. He submitted that the form of clause in the Bill was sufficient.

Mr. Morton said that what he proposed had been inserted in the case of the Charing Cross and Strand Co.

Mr. Fitzgerald: They are not a power company.

Mr. Morton called Dr. Saunders, Medical Officer of Health for West Ham, who said there were now two generating stations in the borough, and they were both subject to the general law.

Mr. Fitzgerald having read the passage from Lord Cross's report, the Committee refused the amendment, and ordered Clause 3 to stand part of the Bill.

On Clause 4, Mr. Freeman, K.C. (for various borough councils), raised the question of the definition of the word "consumer"; and Mr. Lewis Coward, K.C. (for the L.C.C.), objected that one section of the clause "gave the promoters an unlimited right of supply."

After hearing arguments from both sides, the Committee decided that Clause 4 should stand part of the Bill.

(To be continued.)

The consideration of clauses occupied the Committee the whole of Monday and part of Tuesday. On the latter day the Committee ordered the Bill as amended to be reported to the House. On Thursday evening a proposal that the Bill be suspended until next Session was to come under consideration in the House of Commons.

Metropolitan Electric Supply Co., Ltd. (Various Powers) Bill.

A Select Committee of the House of Commons under Mr. Russell Rea, sat on Tuesday and Wednesday last week to consider the above Bill. The promoters were represented by Mr. Balfour Browne, K.C., Mr. Ram, K.C., and Mr. Talbot. The opponents were the Charing Cross, West End and City Electric Supply Co., represented by Mr. Baggallay, K.C., Lord Robert Cecil, K.C., and the Hon. Sidney Holland; the Fulham Borough Council, represented by Mr. Jeaves; the Hampstead Borough Council and the Marylebone Borough Council, represented by Mr. Lloyd, K.C., and Mr. Vesey Knox; and the London County Council.

Mr. Balfour Browne, K.C., said the Metropolitan Electric Supply Co. was incorporated in 1887, and its authorised capital was £3,000,000. It had actually raised £1,850,605. The districts it was authorised to supply in were part of the parish of St. Martin-in-the-Fields, part of the city of Westminster, the St. Giles, Holborn, and Strand district, Marylebone and Paddington. Up to 1898 the company had erected and equipped five generating stations. About that year the company purchased a piece of land at Willesden for £12,500, and erected a generating station, and Bills were brought in which enabled the company to bring mains from Willesden to carry the energy to the districts of supply. In 1903 they purchased more land at Willesden, and they now had 18 acres. In 1901 the St. Marylebone Borough Council promoted a Bill to supply themselves with electricity, and this ultimately resulted in the purchase by the Borough Council of the undertaking of the company

within the borough. At Willesden the company had a capacity to generate 16,500 KW., and as the Marylebone Borough Council would ultimately supply themselves, they would be left with a far larger capacity at Willesden than they wanted. They had arranged to supply the Acton district through the local authority, and the Bill now before the Committee was to authorise the company to supply a large area in bulk, including the following districts:—Marylebone, Hampstead, Fulham, Acton, Chiswick, Brentford, Ealing, Hanwell, Southall-Norwood, Greenford, Uxbridge, Hayes, Heston and Isleworth, Twickenham, Teddington, Hampton Wick, Hampton, Sunbury-on-Thames, Feltham and Staines. Most of this area was included in the area asked for by the Administrative County of London Co., but Lord Camperdown's Committee decided that the Metropolitan Co. should have the West End district. There was, however, a great difference in the powers asked for by the two companies. The Administrative Co. asked for power to supply manufacturers in their industrial area with energy direct, but all the Metropolitan Co. asked for was to supply authorised distributors in bulk.

Mr. LLOYD: You are seeking to put Hampstead into your Bill, and the moment you get me into your district I am prohibited from taking my surplus from any other company.

Mr. BALFOUR BROWNE said that was entirely wrong. Their intention was, no doubt, to supply Hampstead with energy, but, so far as he knew, there was to be no monopoly. The only way in which he could affect the opposing local authorities was by the clause which had been introduced into many other Power Bills, and which gave the company power to supply electricity to railways and canals for haulage whom he might supply in his own district for use outside the district. There was absolutely nothing in the Bill to compel the Boroughs of Hampstead or Fulham to take one unit of energy from them. All the Bill did was to authorise the company to supply the local authorities if they wanted a supply.

The CHAIRMAN: So long as they make it themselves.

Mr. BROWNE: Or get it from anyone else.

Mr. LLOYD said the promoters had made arrangements with other companies prohibiting those companies from supplying the local authorities, and then they took those local authorities' districts into their district.

Mr. BROWNE said the policy of his company had always been that there should be no competition between companies during the short lease of life they had. That was the reason why they struck out the districts of Kensington and Hammersmith from the Bill, for there were companies supplying there. If to-morrow the Fulham Borough Council put up a generating station, it need not take a single unit from the Metropolitan Co. He contended that the Charing Cross Co. had no *locus standi* at all, but, unfortunately, they were unable to get a Court of Referees to sit before the Bill came on.

Mr. JOHN CONACHER, general manager of the Metropolitan Co., was called, and gave evidence bearing out counsel's statement.

In cross-examination, WITNESS said it was perfectly true that the company could supply any railway in Fulham from a point outside, but at the same time it might be desirable to give the supply at some point in Fulham.

Mr. JEAVES put it to witness, that by the agreements made with his company and the other power companies, these companies would not be able to supply in the West End area without the consent of the Metropolitan Co., and that that would practically secure a monopoly for his company.

WITNESS said that these were arrangements entered into with other companies, and had nothing to do with the Bill before the Committee.

The CHAIRMAN said the Committee were unanimously in favour of the principle of the company being allowed to supply railways inside and outside their area.

Mr. JEAVES said the Fulham Borough Council quite agreed with the principle, but objected to the methods by which it was proposed to apply it. They contended that there could be no railway in Fulham which could not be conveniently supplied from outside without bringing Fulham into the area of supply.

Further evidence was called in support of the Bill.

On Wednesday, Mr. LLOYD, K.C., addressed the Committee, and said there was no provision made in the Bill for the supply of power in the ordinary sense of the term. It was merely a Bill to enable the company to supply certain distributors in bulk. There were five municipal boroughs originally included in the Bill, but two had been dropped out, and the other three—Hampstead, St. Marylebone and Fulham—were the three for which the promoters asked for additional powers. It was said that the idea of the House of Lords was to divide London into districts for the purposes of power, but, as a matter of fact, the West End was in exactly the same position as the South part of London, which was in the area of the Administrative Co. so far as power supply was concerned. Of course, it might be desirable for the Metropolitan Co. to spread their net as far as they conveniently could; but he asked if it was in the interests of Hampstead that they should be brought within the meshes, having regard to the position which that borough occupied. The point was that Hampstead was contiguous to the North Metropolitan Electric Power Co.'s area, and also to the area asked for by the Administrative County of London Co., and why should he not have the privilege of obtaining a supply from either of these companies? If that Bill was passed, he admitted that the company would be under an obligation to supply him, but he would by a stroke of the pen be married to the company against his will, and was prevented from ever making a bargain for bulk supply with other persons. He did not think that was fair or for the public benefit, and with regard to the maximum prices in the Bill he found that they only offered at a price which would be higher than the local authority could generate at for itself. So far as Marylebone was concerned, there was an existing obligation on the part of the company to supply to the local authority should they require such a supply in bulk, and he failed to see what more the promoters wanted. The agreement had been confirmed by Parliament, but, seemingly, the company did not think it effected the purpose for which it was framed. He submitted, however, that the Act was perfectly clear, and having tried honestly to see what different construction could be placed upon it he had failed. It was a matter of public property that the Metropolitan Electric Supply Co. had been paid a very large sum of money for that part of their undertaking which was in Marylebone, and it was somewhat surprising to find them once more trying to get the borough into their area. With reference to the power being sought by the company to supply energy to railway companies, he did not for a moment deny that it was a great advantage for a railway company to be supplied from one source, but in the light of what had passed, it was a little hard on Marylebone that the company should want to come into their district even for that purpose; the fact was that Marylebone wanted to hear as little of the company as it could in the future.

The CHAIRMAN, addressing Mr. Balfour Browne, said that it would probably tend to shorten the proceedings if he stated the opinion of the Committee on several points. In the first place, they were agreed not to differentiate a borough which was on the border of the area, as this would be unjust to other districts, and consequently the contention of Hampstead would not be allowed. The Committee also agreed that there was nothing in the opposition of the Charing Cross and Strand Electricity Co. to affect their decision. With regard to Marylebone, however, the Committee did feel in a little difficulty. They were in favour of Clause 21, which gave the company power to supply to railway companies, but they did not want anything to be put into the clause which would inadvertently override the existing agreement with Marylebone.

Mr. BALFOUR BROWNE expressed his willingness to put in a clause saving any existing agreement, but the company felt that since Mr. Justice Farwell's decision in the Willesden case they might not have the right to supply Marylebone in bulk, notwithstanding the existing agreement. At present neither the company nor the Marylebone Council could enter into a new agreement.

The CHAIRMAN remarked that the Committee had no wish to act as a Court of Law, and, consequently, they desired to have a stringent clause inserted safeguarding the present position of the Borough Council.

Mr. BALFOUR BROWNE pointed out that with regard to tramways and railways the company did not sell this right in 1901, as they did not possess it. Even at present the company did not have the right, and, therefore, it could not have been bought from them in 1901.

The CHAIRMAN said it was just this point which the Committee did not wish to determine, but to leave open to arbitration.

Mr. BALFOUR BROWNE suggested the insertion of the following proviso: "Nothing in this Act shall confer upon the company any right if it were purchased by the Council in 1901."

Mr. VESEY KNOX said he could not accept the wording suggested.

After further discussion, the following proviso was brought up and agreed upon: "Provided that if by virtue of anything in this section the company shall acquire any right in respect of the Borough of St. Marylebone for which the company shall have received compensation upon the purchase of the Marylebone undertaking and the business of the company under Electric Light Provisional Order Confirmation Act No. 1, 1901, the company shall repay to the Council of the said borough such proportion, if any, of the purchase money and compensation received by the company under the said Act as represents the value of such right."

The preamble was then declared proved, and the clauses having been adjusted, the Bill was ordered to be reported for third reading.

The Bill was read a third time in the House of Commons on Monday.

North-East London Railway.

Wednesday, August 2nd.

On the above date, Lord Ludlow's Select Committee of the House of Lords commenced the consideration of the North-East London Railway Bill. Mr. Balfour Browne, K.C., Mr. Page, K.C., and Mr. L. Macassey represented the promoters, and the only opponents were the Great Eastern Railway Co.

Mr. BALFOUR BROWNE, in opening the case, said it was a proposal to incorporate a company, and to authorise the construction of a very important railway, which, starting from the City, would give access to the North-Eastern districts of London. The scheme was to start from the Monument, and to proceed *via* Bishopsgate Street, Shoreditch to Leyton, Walthamstow, Chingford and Waltham Abbey. The line would be about 14½ miles long, and while it was intended to construct the first four miles in a tube, the line would afterwards be upon the surface. It would be worked electrically, and multiple unit trains would be used. The estimates for the works and lands were £2,692,405, which was exclusive of rolling-stock, generating stations, lifts, legal expenses, and so on, and the total cost was exceedingly low, being only £275,862 per mile, as compared with £700,000 a mile, which was the cost of the Central London Railway. Of course, the reason for the great difference in the cost was owing to the fact that such a large part of the line would be on the surface. The Bill proposed to authorise the company to raise £3,000,000 capital, with the usual borrowing powers of one-third. With regard to the question of the desirability of having such a railway, it might be said that they had anticipated the report of the Royal Commission on London

Traffic. It was a route with regard to which several railway schemes had been promoted, but these had fallen through on financial grounds. With regard to the question of finance, he believed there was a great deal of misconception as to the attitude of Messrs. Morgan and Yerkes in respect of the tube railways they had promoted of recent years. It appeared to be assumed that, because these gentlemen guaranteed the raising of the capital, they were prepared actually to put the money down on the table before the Committee, but all the guarantee meant was that these gentlemen, with the assistance of their friends, would find the necessary capital. Of course, no financier would actually guarantee any capital before a Bill was passed. He was glad to say, however, that in connection with the North-East London Railway scheme the difficulties of finance had been overcome, and he should call witnesses well known in the city with regard to that point. Moreover, a responsible firm of contractors had agreed to carry out the work on the engineer's estimates, and to take £800,000 in shares at par value in part settlement of their claim. The Bill had the support of the local authorities and the London County Council, and the City Corporation, who were former opponents, had withdrawn their opposition. The only actual opponent was the Great Eastern Railway Co., but he submitted that that company could not carry the traffic which now existed, to say nothing of the demands of the future. He would also direct the Committee's attention to the fact that the Great Eastern Co. in 1901 actually favoured one of these schemes. When the Bill was before the other House several important conditions were laid upon the promoters, and, amongst other things, they would be obliged to convey workmen from Walthamstow for 2d. At first it was thought that this would result in considerable loss, but estimates since made showed that such traffic could be carried without loss, although without profit. Another condition put upon them was that half of the capital was to be subscribed within 12 months, but only half the shares taken by the contractor were to count in that. They were further bound to make a substantial commencement of the work within two years.

Mr. C. Warner, M.P., was called, and gave evidence of the great need of an additional railway to Walthamstow.

Thursday, August 3rd.

At the sitting of the Committee on Thursday, Mr. Morgan, M.P. for Walthamstow, described the crowded state of the trains at present on the Walthamstow line of the Great Eastern Railway. He considered the route of the proposed new line a most desirable one. He had been requested by every local authority through which the railway would pass to support the Bill. He was in no way connected with the promotion of the line, nor was he financially interested. He was told that Mr. Marten, Mr. Braithwaite, Mr. Grenfell and Sir T. Troubridge were the gentlemen who were responsible for the finance of the Bill, and he knew of them as responsible men in the City of London.

In cross-examination, Witness said the Great Eastern Railway Co. had done a great deal, but he was not aware that while in the last 10 years the population had increased 40 per cent., the seating accommodation had increased 55 per cent. and would shortly be increased to 72 per cent.

Evidence of a local character was given by Mr. Sheldrake, of Leyton, and the Hon. Claud Hay, M.P., the latter saying that he had no wish to pin down the Great Eastern Railway, who were undoubtedly doing their best to carry the traffic.

Sir Douglas Fox, the engineer, said that the total cost of the works and land for the railway was estimated at £2,546,400, to which another £80,000 or £90,000 would have to be added for equipment. To comply with the decision of the House of Commons' Committee, the tube levels between the Monument Station and Hackney Road had been lowered so as to admit of the construction of another pair of tubes above the proposed railway. He thought that it would be easy to arrange protective clauses with the Great Eastern Railway where the line crossed theirs. The crossing presented no engineering difficulties.

Answering Mr. Freeman, Sir Douglas said he was quite ready to admit that the Great Eastern Co. had done all they could to meet the constantly growing traffic on their line to Walthamstow. They had promised to provide an additional line; this promise, however, had not been kept. The decision of the House of Commons' Committee reducing the fare from the City to Forest Road to 2d. would reduce the gross receipts by about £12,000, and to that extent the basis of his memorandum, on which financial support for the scheme had been obtained, was altered. He did not think that the imposition of the 2d. fare would kill the project.

Sir Alexander Binnie, Mr. A. C. Morton, C.C., Col. Lockwood, M.P., and Mr. T. H. Robertson, M.P., having given evidence in favour of the Bill, Mr. E. W. Stanyforth, one of the promoters, and a director of the Lancashire and Yorkshire Railway Co., said he was confident that there would be no difficulty in raising the capital even under the proposed 2d. fare. Personally, he was prepared to take a substantial financial interest in the company.

Other evidence having been given by Mr. J. H. Buxton and Sir T. Troubridge as to the financial part of the scheme, the Committee adjourned.

Friday, August 4th.

On Friday evidence was given by Mr. Biddulph Martin, M.P., chairman of Martin's Bank, Ltd., to the effect that there would be no difficulty in raising the capital necessary for the railway.

Mr. Stephen Sellon, who had examined all the details of the scheme, said he estimated that the railway would carry 44,525,000 passengers annually. With regard to the obligation which the House of Commons had put upon the promoters to carry workmen between the City and Walthamstow at 2d. fares, he did not think that would have so serious an effect financially, but it would conduce to the congestion of traffic for short periods. It would mean congestion on both this railway and the Great Eastern Railway at certain periods of the day, and his idea in putting on the 3d. fare was to divide the traffic. When he was before the House of Commons' Committee he was working on estimates, and based his conclusions as to receipts on an average fare, but Mr. Gooday, the general manager of the Great Eastern Railway, had given actual figures of traffic, and from Mr. Gooday's figures he found that more workmen travelled at the higher workmen's fare of 4d. than travelled at the 2d. fare. He estimated to get £420,138 from traffic and £12,000 from sundry receipts, such as advertisements, and he did not think the latter figure was too high, because the Central London Railway, with half the length of route, got more. The working expenses would be £206,042, making net receipts of £226,076. Taking the capital at £4,000,000, it would enable them to pay 5 per cent., and leave a balance of £26,096. As, however, £1,000,000 of the capital would be debentures, they would only pay 4 per cent. on them, but they would, of course, have to provide a certain amount for depreciation. He took the working expenses at 46 per cent., and that compared favourably with the existing tube railways in London. The Central London was 52 per cent., the Waterloo and City 47 per cent., and the City and South London 46 per cent. He would point out that as the Central London and the City and South London had to use lifts, that put an extra expenditure of about 8 per cent. on them for working expenses. He had come to the conclusion that the line would be a paying one. When he said that the 2d. fare would kill the railway, he had in mind the attempt of the London County Council to get a 2d. fare for workmen over the whole of the line. The 2d. fare would not be remunerative, and it was on the higher fares that they expected to get a profit.

Mr. Balfour Browne: I understand that even taking passengers from Forest Road to the Monument is not in itself particularly remunerative?—There will be a loss.

Further examined, Witness said it was intended to carry workmen by trains reaching the City up to 7 o'clock for 2d.; up to 7.30 for 3d.; and up to 8 o'clock for 4d. He thought the line would be an exceedingly good investment as compared with other tubes in London. Witness proceeded to deal with the district through which the line would run, to show its capabilities for a remunerative traffic.

Evidence having been given by Sir M. Bhownaggree, M.P., in support of the Bill, the evidence for the promoters closed.

Mr. Gooday, general manager of the Great Eastern Railway, gave evidence in opposition to the Bill, and contended that Mr. Sellon's figures were fallacious, and contrary to the experience of his company.

Other evidence of a similar character was called, and the Committee adjourned.

Saturday, August 5th.

Mr. Freeman, K.C., in addressing the Committee in opposition to the Bill, on behalf of the Great Eastern Railway, said it was inconceivable that the railway would be able to get the 44 million passengers a year on which Mr. Sellon had based his estimates, and if it did not, the line could not be a financial success.

Mr. Balfour Browne, K.C., for the promoters, claimed that the estimate of passengers to be carried was likely to be borne out in view of the greatly improved travelling facilities which the line would give, and which would undoubtedly have the effect of enormously developing building in the districts through which it would run. He asked the Committee to say that they were quite satisfied that the money would be forthcoming if the Bill passed.

The Chairman said the Committee were of opinion that the Bill should proceed, and, after the adjustment of clauses, it was ordered to be reported to the House for third reading.

Third Readings.—In the House of Commons on August 3rd, the Central Electric Supply Bill was read a third time.

In the House of Commons on August 4th the Oldham and Saddleworth District Tramways Bill was read a third time.

COAL GAS AND ITS RIVALS FOR MOTIVE POWER.

The above was the subject of a lecture given by Mr. Dugald Clerk, M.I.C.E., to the North of England Gas Managers' Association on April 29th at Newcastle-upon-Tyne.* Referring to his suggestion made three years previously, that a much cheaper gas was desirable, the lecturer considered that the trend of events had since pointed more strongly than ever to the desirability of a public supply of coal gas for power purposes at 1s. per 1,000 cb. ft. Discussing the competition with steam engines, he considered that gas of 600 B.TH.U. at that price would enable coal gas to cover the field up to 150 H.P. In regard to this low price for gas, it was pointed out that the present intrinsic illuminating power could not be expected therewith. This was not considered a disadvantage, now that the incandescent mantle had come into common use, as it was more

* This abstract is from the full report of the lecture which appeared in the *Gas World*, May 6th, 1905.

dependent upon flame-temperature than illuminating power in the gas; but he was sorry to find that the opposition to the reduction of illuminating power was supported by leading gas manufacturers. The question of comparative costs of gas and electricity was dealt with at some length, and the low cost at which electrical energy could be supplied, when the most economical reciprocating steam engine or turbine was employed, was instanced, the works cost at one station being as low as 0·132d. per unit produced. While the most usual charge is about 1½d. per unit, the lecturer anticipates that in a few years electrical energy for motive power will be freely supplied at 1d. per unit, or under, and gives the output of electro-motors at present in work in Greater London as something like 36,000 H.P. From a table of the price of coal gas for power, prepared from the principal districts of Britain, the maximum and minimum of the figures given are as follows, taking the average prices, and assuming the calorific value of gas at 600 B.TH.U. per cb. ft., and allowing for interest, depreciation, attendance, and other charges:—

—	Prices per 1,000 cb. ft.				Per B.H.P.-hour, 80 per cent. brake eff.		Per B.H.P.-hour, 25 per cent. brake eff.	
					Fuel cost.	Total cost.	Fuel cost.	Total cost.
	s.	d.	s.	d.	Average.	d.	d.	d.	d.
Glasgow	2	0	— 3	0	2s. 6d.	0·43	0·53	0·52	0·62
Widnes	1	0	— 1	4	1s. 2d.	0·20	0·30	0·24	0·34

At 2s. per 1,000 cb. ft., an ordinary gas engine would give a B.H.P.-hour for rather less than 0·4d. for fuel alone, and for about 0·5d. total. At 1d. per unit, electrical energy is equivalent to 0·75d. per E.H.P.-hour delivered to the consumer, or, with a motor efficiency of 85 per cent., the power costs 0·88d. per B.H.P.-hour.

In considering how electrical competition might be met, it was stated that even with London gas a moderately good gas engine could give its power for rather over half the cost of electricity, but that the electric motor had advantages, in regard to starting, over the gas engine, besides for many purposes rendering countershafting unnecessary.

Cases were referred to where electricity at 2d. per unit had been replaced by gas at 1s. 9d. per 1,000 cb. ft., with a reduction of cost to about one-sixth.

The lecturer stated that electricity companies were pressing very hard to supply energy for motive power, and that a certain field would doubtless always be theirs, but if equal pressure were applied by gas companies and gas engine makers, he was convinced that the electrical companies would be prevented from seriously invading the field of large powers; and he proposed that for small powers gas engines should be let out on hire, in the same way that electrical companies let out motors. The estimated power of gas engines in use in Great Britain and Ireland was about 1,000,000 H.P., mostly driven by coal gas, while the coal gas production of the country appeared to be divided equally—25 per cent. illumination without mantles, 25 per cent. with incandescent mantles, 25 per cent. gas stoves, and 25 per cent. gas engines.

The lecturer next turned his attention to the larger class of gas engines, up to 2,000 H.P. and over, that are now available, as well as the increased application of the poorer class of gas from producers, coke ovens, blast furnaces, &c.; he also dealt with petrol and other motors, and gave some very interesting statistics of suction producers.

As an example, he compared the cost of 30 B.H.P. for one year at an average load of 20 B.H.P. by suction gas, and 20 B.H.P. by coal gas at 1s. 6d. per 1,000 cb. ft., the total cost of the former coming out at £60 and of the latter at £74.

The advantages of the suction producer over the pressure type, are—low first cost, absence of gas-holder, ease of starting, and small amount of attention required.

NEW PATENTS APPLIED FOR.

Compiled expressly for this journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

15,196. "Improvements in systems of telephony." THE BRITISH THOMSON-HOUSTON CO., LTD. (The General Electric Co., United States.) July 24th.

15,206. "Improved construction of electrical resistance apparatus." E. HAERTEL and A. JENSEN. July 24th.

15,222. "Improvements in fuse heads for electric blasting." F. RENDER. July 25th.

15,224. "Improvements in the joints of silver or electro-plated table ware and the like." J. F. HOMER. July 25th.

15,242. "Sparking plug for electric ignition for use with oil, gas and petrol engines." F. J. SCOTCHMER. July 25th.

15,252. "Improved means for operating switches employed in electric traction on the surface contact system." R. BROWN. July 25th.

15,253. "Improvements in switches employed in electric traction on the surface contact system." R. BROWN. July 25th.

15,254. "Improvements in switches for electric traction on the surface contact system." R. BROWN. July 25th.

15,257. "Storage batteries." W. GARDINER and C. P. STRINGFIELD. July 25th. (Complete.)

15,265. "Improvements in electro-magnetic vibrators." R. CARLSTEDT. July 25th. (Complete.)

15,279. "Improvements relating to battery holders for automobiles." F. JACKSON. July 25th. (Complete.)

15,219. "Improvements in and relating to telephone call registers." A. MEYER. July 25th. (Complete.)

15,290. "Transportable telephone apparatus." N. JACOBSEN. (Date applied for under Patents Act, 1901, December 16th, 1904, being date of application in Norway.) July 25th. (Complete.)

15,298. "Improvements in multiple telegraphy." S. F. JONES. July 25th. (Complete.)

15,299. "Improvements in multiple telegraphy." S. F. JONES. July 25th. (Complete.)

15,301. "Improvements in signalling devices or telegraphs." DE COURCY BEAMISH. July 25th.

15,380. "An improved process for the electrolytic manufacture of metallic wire or strip." S. O. COWPER-COLES. July 26th.

15,381. "Improvements in the electrolytic production of metallic strip." S. O. COWPER-COLES. July 26th.

15,390. "Improvements in the manufacture of electrical resistances." C. RUZICKA. July 26th.

15,397. "An improved electrical signalling apparatus for electric lights or lamps." M. TELFORD, T. GRIER and G. F. MACKAY. July 27th.

15,435. "Improvements in and connected with the employment of telephone meters in common microphone battery system." H. OPPENHEIMER. (Aktiengesellschaft Mix & Genest, Germany.) July 27th.

15,462. "Improvements in the process of making a metallic connection between the light emitting bodies and the supply conductors of electric glow lamps." H. KUZEL. July 27th.

15,464. "Improvements in and relating to electric switches." J. W. COOK. July 27th.

15,479. "A contact hood for use in raising and lowering electric arc lamps and other apparatus." C. E. G. GILBERT. July 28th.

15,546. "Improvements in apparatus for controlling and operating the points of electric railways and tramways." W. H. TURNER, R. E. DIXON and T. B. STEWART. July 29th.

15,561. "Improvements in the production of metal articles or metal-covered articles by electro-deposition." F. I. GIBBS. July 29th.

15,577. "A new or improved cut-out for overhead tramway wires." F. C. MORRIS and J. O. HART. July 29th.

15,586. "Improvements in sparking plugs." H. LUTHI. July 29th. (Complete.)

15,590. "Improvements relating to points or switches for electric tramways working upon the slot conduit system." A. N. CONNETT. July 29th. (Complete.)

15,591. "Improvements in devices for electromagnetically influencing the arcs of electric arc lamps working with alternating current." T. L. CARBONE. July 29th. (Complete.)

15,594. "Improvements in the conveying of currents to electrodes arranged in electrically-insulated tubes." GANZ & Co. (Eisengiesserei und Maschinen-Fabriks Act Ges m.b.H.). (Date applied for under Patents Act, 1901, August 26th, 1904, being date of application in Germany.) July 29th. (Complete.)

PUBLISHED SPECIFICATIONS.

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1904.

STARTING AND CONTROLLING ELECTRO-MOTORS AND CIRCUIT BREAKERS ADAPTED FOR USE THEREIN. B. N. Dadge and S. Lord. 9,711. April 28th.

VAPOUR ARC LAMPS. C. O. Bastian. 9,718. April 28th.

VAPOUR ELECTRIC RECTIFIERS. E. A. Carolan. (General Electric Co., United States.) 10,341. May 5th.

GALVANIC BATTERIES. Siemens Bros. & Co., Ltd., and W. F. Eichenauer. 10,559. May 17th.

CONDUCTING CHEMICAL REACTIONS BY MEANS OF MERCURY VAPOUR ARC. E. A. Carolan. (General Electric Co., United States.) 10,881. May 11th.

CEILING OR WALL ROSETTES FOR ELECTRIC LIGHTING AND HEATING. A. P. Lundberg and G. C. Lundberg. 11,056. May 13th.

SWITCHES. The British Thomson-Houston Co. (Allgemeine Elektricitats-Gesellschaft, Germany.) 11,073. May 13th.

ARC LAMPS. H. Winkler. 11,650. May 20th.

MINERS' SAFETY LAMPS. J. P. Rees. 11,943. May 25th.

ALTERNATING CURRENT ELECTRIC MOTORS. F. W. Davies. 12,123. May 28th.

ELECTRODES AND LAMPS FOR ARC LIGHTING. E. A. Carolan. (The General Electric Co., United States.) 12,247. May 30th.

ELECTRIC RESISTANCES. W. J. Davy. 12,267. May 30th.

DYNAMO-ELECTRIC MACHINES. British Thomson-Houston Co. (Allgemeine Elektricitats-Gesellschaft, Germany.) 12,334. May 31st.

ALTERNATING CURRENT MOTORS. British Thomson-Houston Co., Ltd. (Allgemeine Elektricitäts Gesellschaft, Germany.) 12,336. May 31st.

FIRE ALARMS AND THERMO-INDICATORS. A. H. McNeil and the Pearson Fire Alarm, Ltd. 12,376. May 31st.

TELEGRAPH RECORDER. W. J. Roussel and A. King. 21,848. October 11th.

SUPPORTING ELECTRIC TRAMWAY OVERHEAD POWER-TRANSMITTING OR TROLLEY WIRES. J. W. Allen. 22,839. October 24th.

DISTRIBUTION OF ALTERNATING ELECTRIC CURRENT. A. F. Berry. 23,150. October 27th.

CONTROLLING SYSTEMS FOR ELECTRIC MOTORS. A. C. Eastwood. 26,096. November 30th.

MOTOR CONTROLLING SYSTEMS. A. C. Eastwood. 26,099. November 30th.

TROUGHS OR CONDUITS FOR UNDERGROUND ELECTRIC MAINS. J. Wilkinson. 26,220. December 2nd.

SWITCH INSTALLATIONS FOR TELEPHONE EXCHANGES AND SWITCHES THEREFOR. Siemens Bros. & Co., Ltd. (Siemens & Halske, Akt. Ges., Germany.) 26,282. December 2nd.

GRID OR ELEMENT FOR SECONDARY BATTERIES. W. Gardiner. 27,905. December 20th.

SAFETY DISCHARGE APPARATUS FOR EXCESSIVE VOLTAGES IN ELECTRIC CURRENTS. Siemens Bros. & Co., Ltd. (Siemens-Schuckertwerke G.m.b.H., Germany.) 28,018. December 21st.

STARTING AND BRAKING DEVICE FOR ELECTRIC MOTORS. A. Hultquist. 28,471. December 27th.

ELECTRIC MASSAGE APPARATUS. L. Kublitz. 28,704. December 29th.

CONTROLLING ELECTRIC MOTORS. W. Giepel, F. M. T. Lange and G. W. Mascord. 5,213. March 2nd.

CONTROLLING ELECTRIC MOTORS. W. Giepel and F. M. T. Lange. 5,214. March 2nd.

ARC LAMPS. Ganz & Co., Eisengiessesei-und Maschinenfabriks Akt. Ges. 8,693. April 15th.

ALTERNATING CURRENT ARC LAMPS. Ganz & Co., Eisengiessesei-und Maschinenfabriks Akt. Ges. 8,694. April 15th.